EIGHTH WORKSHOP ON RUSSIAN-GERMAN COOPERATION:

LAPTEV SEA SYSTEM

Process Studies on
Permafrost Dynamics in the Laptev Sea

Program and Abstracts

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Program

EIGHTH WORKSHOP ON RUSSIAN-GERMAN COOPERATION: LAPTEV SEA SYSTEM

Tuesday, February 7, 2006

Registration

17:00-18:00	Registration at the AARI (small conference room, first floor)
18:00	Reception in celebration of the 5th Anniversary of the Otto Schmidt Laboratory for Polar and Marine Research (small conference room and cafeteria at the AARI) Moderation: Prof. Timokhov and Dr. Kassens Welcome address: • Prof. Frolov and Prof. Thiede Opening addresses: • Dr. Imerekov and RD Ollig • Prof. Cherkashov and Prof. Fütterer • Prof. Dmitriev

Wednesday, February 8, 2006

Welcome and opening remarks

10:00	Welcome and opening remarks (Chairperson: S. Priamikov) • Dr. K. Voronin (Minobrnauki) • Dr. H. Prasse (BMBF) • Prof. I. Frolov (AARI) • Prof. J. Thiede (AWI)
11:00	The Otto Schmidt Laboratory for Polar and Marine Research *L.A. Timokhov*
11:20	Process studies on permafrost in the Laptev Sea *H. Kassens and the project members*
11:40	The dynamics of permafrost in the Laptev Sea region, Russia *H.-W. Hubberten and the German-Russian Team*
12:00	Lunch

Oral session: Development and stability of permafrost

Chairperson: E.-M. Pfeiffer

13:00 Main results of the marine permafrost drilling campaign 2005 in the coastal zone of the western Laptev Sea
M. Grigoriev, V. Rachold, V. Kunitsky, R. Junker, D. Bolshiyanov

13:20 Temperature regime of the transition zone from terrestrial to sub-sea permafrost at Mamontovy Klyk/Laptev Sea
R. Junker, M.N. Grigoriev, V. Rachold, N. Kaul

13:40 The high resolution acoustic sounding technique as one of the possible basements for the offshore permafrost study
P. Rekant, E. Gusev, P. Krinitsky, G. Cherkashov, T. Schwenk, V. Spiess, H. Kassens

14:00 Structure of Late Quaternary sediments and submarine permafrost in the Laptev Sea – results from multichannel seismic survey during expedition TRANSDRIFT X
T. Schwenk, V. Spieß, P. Rekant, E. Gusev, H. Kassens

Poster session I

14:20 Poster session with short introduction by E.-M. Pfeiffer
Coffee

Oral session: Development and stability of permafrost (continued)

15:20 The thermal response of the Laptev Sea to wind, temperature, and oceanic forcing
J. Hölemann, C. Wegner, S. Kirillov, N. Koldunov, C. Haas, T. Krumpen, V. Churun, L. Timokhov, H. Kassens

15:40 Seasonal bottom-water temperature variations on the Laptev Sea shelf – evidence from one-year records
C. Wegner, J.A. Hölemann, D. Bauch, S. Kirillov, N. Koldunov, V. Churun, I. Dmitrenko, L. Timokhov, H. Kassens

16:00 Large-scale atmospheric circulation over the Arctic: impact on thermal regime of the continental shelf of the Laptev and East-Siberian seas through the benthic Atlantic Waters penetration
S.A. Kirillov, M.S. Makhotin, N.V. Koldunov

16:20 Laptev Sea hydrographic expedition data from 1993 to 2003: interannual variations and exchange with the Arctic Ocean interior
D. Bauch, C. Wegner, J.A. Hölemann, S. Kirillov, N. Koldunov, V. Churun, I. Dmitrenko, M. Nitishinsky, L. Timokhov, H. Kassens

16:40 Sources, pathways and transformation of nutrients in the Laptev Sea
A. Novikhin, M. Nitishinsky

17:00 Zooplankton investigations in the Lena Delta and on the Laptev Sea shelf
E. Abramova, I. Vishnyakova, S. Kirillov, D. Ivanova, E. Vinogradova

17:20 Internal meetings

Thursday, February 9, 2006

Oral session: Short and long-term environmental changes in the central Siberian Arctic

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Chairperson: M.N. Grigoriev

10:00 Environmental history of the Laptev Sea: present status and future perspective
H.A. Bauch, H. Kassens, T. Klyuvitkina, H. Meyer, T. Müller-Lupp, Ye. Polyakova, P. Rekant, E. Taldenkova

10:20 The Late Quaternary ground ice at Cape Mamontov Klyk – palaeoclimate archive and terrestrial endmember of the COAST drilling campaign
H. Meyer, D. Magens, L. Schirrmeister, A.Yu. Dereviagin, F. Merker, V. Rachold

10:40 The Late Quaternary history of permafrost landscapes in the western Laptev Sea coastal plain
L. Schirrmeister, D. Magens, G. Grosse, H. Meyer, M. Grigoriev, V. Kunitsky, S. Derevyagin, T. Kuznetsova

11:00 Postglacial evolution of marine and terrestrial environments in the Laptev Sea region deduced from microfossil assemblages
Ye.I. Polyakova, T.S. Klyuvitkina, V.V. Razina

11:20	Postglacial to Holocene environmental changes at the Laptev Sea continental margin as deduced from fossil benthic assemblages *E. Taldenkova, H.A. Bauch, A. Stepanova, A. Strezh, S. Dem'yankov, Ya. Ovsepyan*
11:40	Postglacial environments in the Laptev Sea inferred from dinoflagellate cyst assemblages *T.S. Klyuvitkina, H. Kassens, H.A. Bauch*
12:00	Lunch
13:0	Monitoring past and present environmental changes in the Laptev Sea using ostracods *A. Stepanova, E. Taldenkova, H.A. Bauch*
13:20	Land-Sea Connections in the Arctic Ocean: the Lena Delta *I. Fedorova, D. Bolshiyanov, J. Strelchenko, D. Nikels*
13:40	Late glacial and Holocene pollen records from the Laptev Sea cores and terrestrial section Mamontov Klyk cape *V. Razina, H. Bauch, A. Andreev, L. Schirrmeister, H.-W. Hubberten, H. Kassens*
14:00	Little Ice Age features inferred from lake sediments of the Russian Arctic *M.V. Pavlov, D.Yu. Bolshiyanov, A.S. Makarov*
14:20	QUINSIB – the database of Quaternary insects in northeastern Siberia *A.V. Sher*

Oral session: Microbial-driven processes in permafrost

Chairperson:	H. Kassens
14:40	Geomicrobiological processes in soils and sediments of the Siberian permafrost: results and perspectives *E.-M. Pfeiffer, E. Spieck, D. Wagner, M.N. Grigoriev, A. Kurchatova*

Poster session II

15:00	Poster session with short introduction by H. Kassens Coffee

Oral session:	**Microbial-driven processes in permafrost (continued)**
16:00	Cryostructures of ice complex sequences of the Lena Delta *A. Kurchatova, E. Slagoda*
16:20	Archaeal activity and biomass in permafrost soils and deposits of the Laptev Sea region *D. Wagner, E.-M. Pfeiffer, A. Gattinger, M.N. Grigoriev*
16:40	Molecular characterization of nitrite oxidizing bacteria from permafrost affected habitats using TGGE-analysis *M. Alawi, T. Sanders, E. Spieck, E.-M. Pfeiffer, E. Lebedeva*
17:00	Characterization of nitrite-oxidizing bacteria enriched from permafrost soils in response to different growth temperatures *E.V. Lebedeva, M. Alawi, A. Lipski, E. Spieck, E.-M. Pfeiffer*
17:20	Community size, structure and activity of methane oxidizing bacteria in soils and sediments of permafrost landscapes *U. Zimmermann, C. Knoblauch, M. Blumenberg, E.-M. Pfeiffer*
17:40	Nitrite oxidation in permafrost-affected soils is performed by a newly discovered Betaproteobacterium *E. Spieck, M. Alawi, A. Lipski, E.-M. Pfeiffer*
18:00	Internal meetings

Posters

Monitoring investigations of zooplankton on the Laptev Sea shelf
E. Abramova, I. Vishnyakova , S. Kirillov, D. Ivanova , E. Vinogradova

Molecular characterization of nitrite oxidizing bacteria from permafrost affected habitats using TGGE-analysis
M. Alawi, T. Sanders, E. Spieck, E.-M. Pfeiffer

Interannual variability of summer sea ice characteristics in the Laptev Sea based on shipborne observations and passive microwave data in 2000-2005
T. Alexeeva

Similar water mass processes on the Kara, Laptev and Beaufort shelves is revealed from salinity and $\delta^{18}O$ of H_2O
D. Bauch, H. Erlenkeuser, N. Andersen

The study of global change impact on the Arctic ecosystem with main emphasis on sympagic meiofauna
G. Belozerskiy, A. Moshkina, O. Preobrazhenskaya

Coastal dynamic of the Russian Arctic seas
D.Yu. Bolshiyanov, A.S. Makarov

Lake sediments as an indicator of climatic changes in the Russian Arctic during the last millennium
D.Yu. Bolshiyanov, M.V. Pavlov, A.S. Makarov

Late Quaternary lake level changes of El'gygytgyn Lake inferred from hydrological, geomorphological and tectonic features
G.B. Fedorov, G. Schwamborn, D.Yu. Bolshiyanov, M.V. Pavlov, M. Melles, O. Juschus

Enrichment of ammonia oxidizers from permafrost
C. Fiencke, U. Zimmermann, E.M. Pfeiffer

Nitrification in permafrost soils of the polygonal tundra in Siberia
C. Fiencke, U. Zimmermann, E.-M. Pfeiffer

Composition of methanogenic archaeal communities in permafrost soils of Northern Siberia
L. Ganzert, U. Zimmermann, D. Wagner

Periglacial landscape dynamics and permafrost degradation in the Lena-Anabar coastal lowland - application of Landsat-7 ETM+ data, a digital elevation model and GIS analyses
G. Grosse, L. Schirrmeister, A. Morgenstern

Preliminary results of near shore temperature measurements in boreholes in the Laptev Sea during the COAST I expedition
R. Junker, M.N. Grigoriev, V. Rachold, W. Schneider, V.V. Kunistky, D.Yu. Bolshiyanov, N. Kaul

Abstracts

ZOOPLANKTON INVESTIGATIONS IN THE LENA DELTA AND ON THE LAPTEV SEA SHELF

E. Abramova[1], I. Vishnyakova[2], S. Kirillov[3], D. Ivanova[4], E. Vinogradova[5]
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[3]State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia
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Processes occurring in the pelagic fauna of the Laptev Sea shelf and Lena delta have been studied based on analysis of samples obtained in different parts of the sea and the Lena delta during long- term of investigations. We studied the different aspects of zooplankton existence in these regions: species composition, its seasonal and interannual variations; seasonal variations of the lateral and vertical distribution patterns of planktonic organisms depending upon hydrological conditions; ecological affinity of certain species, primarily their temperature-salinity limits; seasonal and interannual variations of the abundance and biomass of pelagic fauna; life cycles of the common zooplankton species, especially seasonal variations in age and sexual structure of populations, number of generations per year, diapausal stages, etc. We also investigated of zooplankton daily vertical migrations on the Laptev Sea shelf on the basis of daily layer-by-layer catches and daily and yearly ADCP record and analyzed the role of the common Copepoda species (*Drepanopus bungei*, *Pseudocalanus* spp., *Acartia longiremis* and *Oithona similis*) in the sedimentation processes. The filtration rates, feeding rates (ration) of these copepods, composition and concentration of food, daily nutrition rhythm and a number of other factors were analyzed for understanding of processes affected on sedimentation and carbon flux within pelagic ecosystem on the shallow Laptev Sea shelf.

MOLECULAR CHARACTERIZATION OF NITRITE OXIDIZING BACTERIA FROM PERMAFROST AFFECTED HABITATS USING TGGE-ANALYSIS

M. Alawi[1], T. Sanders[1], E. Spieck[2], E.-M. Pfeiffer[3], E. Lebedeva[4]
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[2]Biocenter Klein-Flottbek, University of Hamburg, Germany
[3]Institute of Soil Science, University of Hamburg, Germany
[4]Institute of Microbiology, Moscow, Russia

Nitrogen is one of the most important elements of life. When mineralized from organic material to ammonia, it will be oxidized by nitrifying bacteria to nitrite and further to nitrate. The endproduct nitrate can be used as electron acceptor for denitrification under anoxic conditions. To get more information about the occurrence and diversity of chemolithotrophic nitrifying bacteria in cold environments of the Siberian Artic, we enriched them by using selective media. Environmental samples as well as enrichment cultures from permafrost affected soils (Samoylov Island in the Lena Delta) and marine sediments (Laptev-Sea) were investigated by molecular methods, like 16S rRNA analyses and TGGE-technique (temperature gradient gel electrophoresis). In marine cultures new nitrite oxidizing bacteria belonging to Nitrospira were found, whereas Nitrobacter- and Nitrospira-like bacteria were detected in terrestrial enrichments at 17°C and 28°C. Incubation of soil samples at 4°C and 10°C caused a shift in the community of nitrite oxidizing bacteria towards a so far unknown organism belonging to the Betaproteobacteria.

Molecular investigations allow direct detection of known nitrite oxidizing bacteria in environmental samples as well as a monitoring of the enrichment process. Correlation with cultivation-based techniques like quantification and potential activity measurements enabled identification of relevant nitrifying organisms adapted to extreme conditions. In samples of the active layer (0-5 cm) with a high content of organic matter denitrifying processes occurred, whereas in depths up to 30 cm lithoautotrophic nitrification dominated. Here, microaerophilic microniches seem to provide favourable living conditions for the existence of nitrifying bacteria. Further studies will focus on the diversity of cold-adapted

ammonia and nitrite oxidizing bacteria originating from different sampling sites in North-Eastern Siberia.

INTERANNUAL VARIABILITY OF SUMMER SEA ICE CHARACTERISTICS IN THE LAPTEV SEA BASED ON SHIPBORNE OBSERVATIONS AND PASSIVE MICROWAVE DATA IN 2000-2005

T. Alexeeva
State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

The Laptev Sea is the main source area of the ice to the Arctic Basin (Transpolar Drift). Dynamic factors strongly affect the distribution and variability of the ice cover in this area. However, our recent understanding of the regional and interannual variability of sea ice characteristics is limited by information obtained due to remote sensing.

Remote sensing data is the most important source of information about Arctic sea ice, obtained daily and covering all Arctic regions. However, interpretation of satellite images requires calibration by synchronous data of visual observation. Two observational data sets are used in present research: unique visual data from six high-latitude cruises (RV "*Akademik Fedorov*", i/b "*Kapitan Dranitsyn*") and passive microwave (AMSR) data. Comparative analysis of ice concentration from visual observations and satellite images shows significant differences near the ice edge, while the two datasets agree well in the open water and sea ice covered regions. Interannual variability of sea ice concentration, ice thickness, hummocks concentration, melting stage, and ice pressure were analyzed for summer period of 2000-2005. During the last five years in the Laptev Sea the most difficult ice situation was observed in 2004, and 2005 was marked as the year of minimal sea ice extent in relation to the mean annual values. Detailed research of interannual variability of summer sea ice characteristics in the Laptev Sea in 2000-2005 will be presented in the presentation.

SIMILAR WATER MASS PROCESSES ON THE KARA, LAPTEV AND BEAUFORT SHELVES IS REVEALED FROM SALINITY AND $\delta^{18}O$ OF H_2O

D. Bauch[1], H. Erlenkeuser[2], N. Andersen[2]
[1]Leibniz Institute for Marine Sciences IFM-GEOMAR, Kiel, Germany
[2]Leibniz Laboratory, Kiel University, Kiel, Germany

The water masses of the Arctic Ocean shelf regions are significantly influenced by river water and sea-ice processes. Since river water is highly depleted in $\delta^{18}O$ relative to marine waters as well as to sea-ice, the $\delta^{18}O$ composition and salinity of a water sample can be used to separate the different water sources.

The freshwater distributions on the Kara, Laptev and the Beaufort shelves are discussed based on $\delta^{18}O$ and salinity data. Depending on the average depth the observed fields of salinity and $\delta^{18}O$ values are different for each region. But comparing the $\delta^{18}O$ and salinity correlations reveals a remarkably similarity for these three Arctic shelf regions. On all discussed Arctic shelves bottom water masses are formed by sea-ice processes. And remnants of these bottom water masses are found on all shelves during summer at a similar salinity of about 30.

LAPTEV SEA HYDROGRAPHIC EXPEDITION DATA FROM 1993 TO 2003: INTER-ANNUAL VARIATIONS AND EXCHANGE WITH THE ARCTIC OCEAN INTERIOR

D. Bauch[1], C. Wegner[1], J.A. Hölemann[2], S. Kirillov[3], N. Koldunov[3], V. Churun[3], I. Dmitrenko[4], M. Nitishinsky[3], L. Timokhov[3], H. Kassens[1]
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To evaluate the stability of submarine permafrost the oceanographic boundary conditions have to be investigated. Heat sources on the Arctic shelves are warm river discharge and solar irradiance during summer and potentially the influence of warm Atlantic water passing along the slope of the continental shelf at depth. Therefore investigations on the interaction between atmosphere and water column were carried out with a special emphasis on the exchange of waters from the Laptev Sea and the Arctic Ocean interior.

The water masses of the Arctic Ocean shelf regions are significantly influenced by river water and sea-ice processes and are thereby highly variable within the annual seasonal cycle. Additionally considerable inter-annual differences are seen in the summer hydrography. These inter-annual differences can be clearly seen in the spread of the river plume within the surface layer and are correlated to the average atmospheric conditions of the region. “Offshore” years with mostly southerly and westerly winds during summer cause a predominantly northward spread of the river plume. “Onshore” years with mostly northerly and easterly winds cause the river plume to be trapped in the southern Laptev Sea and to spread along the coast in easterly direction.

Inter annual comparison of temperature and salinity values of cold bottom waters in the southern Laptev Sea (Lena paleo-valley) indicate an enforced exchange of bottom waters here during offshore years compared to onshore years. Bottom waters in the southern Laptev Sea are replaced by relatively fresh waters probably from the western Laptev sea during offshore years.

For an evaluation of water exchange with the Arctic Ocean $\delta^{18}O$ data from “*Professor Multanovski*” expedition in 1994 can be combined with data from the literature located near the shelf break. The $\delta^{18}O$/salinity property plot clearly shows brine enriched waters formed during sea-ice formation in winter. The separation in two mixing lines indicates the existence of a distinctive brine enriched water mass. It is not clear were and when this water mass forms. Even though sea-ice is produced within the reoccurring polynya at high rates and quasi-continuously throughout the winter the summer distribution of brine enriched waters suggests that it may rather be formed during initial freeze up beneath the land-fast ice in the southern Laptev Sea during October to December.

Brine enriched bottom water leaves the shelf and feeds into the upper Halocline of the Arctic Ocean and will in turn be replaced by waters from the halocline. A detailed and quantitative evaluation of shelf basin exchange requires data sets located at the shelf break from single years instead of composite datasets averaging features from several years.

ENVIRONMENTAL HISTORY OF THE LAPTEV SEA: PRESENT STATUS AND FUTURE PERSPECTIVE

H.A. Bauch[1,2], H. Kassens[2], T. Klyuvitkina[3], H. Meyer[4], T. Müller-Lupp[2], Ye. Polyakova[3], P. Rekant[5], E. Taldenkova[3]
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Empirical data as well as modelling experiments show that the stability of the Arctic cryosphere is today under threat due to global warming. Along the circum-arctic ocean

periphery this cryosphere is comprised of terrestrial permafrost. However, during Quaternary times this frozen landscape was repeatedly changed due to global sea-level fluctuations which particularly affected the wide and shallow Siberian shelves. As western part of the Beringian landmass the entire Laptev Sea shelf was subaerially exposed in last glacial times. During the ensuing postglacial global sea-level rise this region gradually changed from a terrestrial permafrost landscape into a shallow marine shelf environment. Various geochemical, micropaleontological, palynological, and sedimentological data obtained from both conventional gravity cores and drill cores reveal the strong influence of this tranformation process on the shelf environment.

Our previous scientific drilling campaign (2000), conducted to the outer Laptev Sea shelf with the goal to recover pre-Holocene sediments from acoustically transparent sections, confirmed the existence of frozen, and ice-bearing terrestrial sediments below a soft, marine sediment package of Holocene age. However, oxygen isotope composition of the ice unveiled that these frozen sediments must have been altered by re-freezing processes during and after the transgression. This assumption seems now corroborated by new high-resolution acoustic data from the mid- to inner shelf region gained during the latest expeditions in 2004.

Although the overall scenario of shelf transformation for the time since the last sea level rise seems to be reasonably well understood now, there is no information available so far from older climatic intervals with conditions comparable to the Holocene. But such information from Holocene-like climate intervals will contribute useful insight for predictive purposes, since these records would then provide a longer time frame within which to evaluate natural variability in general, and means to examine the response of the Arctic system to future changes in particular. The Laptev shelf seas is a crucial area for such paleo-evaluation studies due to its highly changeable environment, both seasonally as well as on longer timescales (decadal to millennial to glacial-interglacial).

THE STUDY OF GLOBAL CHANGE IMPACT ON THE ARCTIC ECOSYSTEM WITH MAIN EMPHASIS ON SYMPAGIC MEIOFAUNA

G. Belozerskiy, A. Moshkina, O. Preobrazhenskaya
St. Petersburg State University, St. Petersburg, Russia

The Arctic pack ice is a special environment for sympagic organisms: bacteria, algae and several metazoan invertebrates (sympagic meiofauna), which are being investigated during our research.

Recent anthropogenic changes in the polar regions are followed by ice cover transformation. This alteration might lead to significant reconstructions of the sympagic community. Thus, the structure and the way of functioning of the ice- and under-ice-ecosystems can be transformed.

This study compares the community in first-year ice and that in multi-year-ice. It allows to analyze an ecological and biological response to climatic changes in the ice organisms environment. The main goal of the work is to interpret the compared results and estimate possible global impact of anthropogenic changes to the Arctic system.

Recently the analysis of multi-year and first-year pack ice sampled in the Greenland Sea during the expeditions ARK-XIII/1,2-1997 (20 stations) and ARK-XII-1996 (12 stations) is carried out in the Institute of Polar Ecology (Kiel, Germany). According to the previous experience of research the ice cores are analysed through the whole profile. Preliminary results confirm the relevance of this method for obtaining more adequate information on composition and quantity of sympagic organisms. Our results show that organisms inhabit not only the lowest horizons but also the internal part of sea ice, that can be the result of increased diameter and joining of brine channels under the exposure of sea-ice melting during the sampling (the summer season). The organisms found are fixated with formaline for further spectrographic analysis in the Otto Schmidt Laboratory.

During the following stages of research we plan to summarize the results and create the complex data base.

COASTAL DYNAMIC OF THE RUSSIAN ARCTIC SEAS

D.Yu. Bolshiyanov, A.S. Makarov
State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

In this study the actual questions regarding the Russian Arctic coast dynamics were considered in connection with hydrometeorolgycal factors. A hydrometeorolgycal index which estimates the duration of coast destruction was proposed. The maps of its spatial distribution for the Russian Arctic coastal zone were created. This factor is the duration of "free-ice period" or period with ice of concentration less than 50%. The map of duration period when the fast ice is absent was created, and the role of fast ice in coast formation was estimated. The map of coastal dynamics of the Russian Arctic Seas, which presents the coastal types, recession rates and rates of recent sea level changes, was created. Analyzing this map it was estimated how recent sea level oscillations impact on the Arctic sea coasts. The classical model of the coast formation with sea level changes proposed by O.K. Leont`ev was supplemented by observation data from the Arctic Russian coasts. In the areas of recent sea level decrease the coasts erode by water in 2-3 times slower than in the areas of recent sea level increase.

LAKE SEDIMENTS AS AN INDICATOR OF CLIMATIC CHANGES IN THE RUSSIAN ARCTIC DURING THE LAST MILLENNIUM.

D.Yu. Bolshiyanov, M.V. Pavlov, A.S. Makarov
State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

The lake sediments of different Russian Arctic regions are studied in the scope of OSL grant, executed in 2004 yr., and works of department geography of Polar Regions in AARI. The following regions were studied: Polar Urals, Taimyr Peninsula, Putorana plateau, Lena Delta, Savernaya Zemlya archipelago. The north-west of Russia is added to these regions over the last years. The short (up to 1 meter) lake sediment cores were subjected to laboratory studying, to obtain the paleoclimatic data during the last millennium. The main paleoclimatic signals have been obtained according to data of spore-pollen, diatom method, geochemical studying of some organic elements and physical properties of sediments. The majority of studied lake sediments have thin varve lamination. It is possible to fix the main climatic events within temporary frameworks, for which chronological analysis of varves has been used (accuracy: 20-30 years). The radiocarbon dating has been applied for poorly stratified sediments.

Thus, we obtained paleoclimatic rows for 14 lakes from different Arctic regions and revealed the cold period, characterized for the Little Ice Age.

The ending of the Little Ice Age in the study area covers 1860-1930s, and the beginning – started in 1480. The time of the beginning and ending of the Little Ice Age differ significantly in several Arctic regions. In addition, at the time of the LIA, a warming phase is identified with the duration of 20 to 100 years. Longer cores of bottom sediments indicate that the periods of warming in the past also alternated with the periods of cooling. In the last 140-70 years, data of all examined cores indicate a warming event. Due to its manifestation before the technogenic era and the presence of cyclic cooling and warming events in the earlier time intervals of the last millennium, it can be concluded that the last warming event has a natural character and will be again replaced by cooling in the nearest future.

LATE QUATERNARY LAKE LEVEL CHANGES OF EL`GYGYTGYN LAKE INFERRED FROM HYDROLOGICAL, GEOMORPHOLOGICAL AND TECTONIC FEATURES

G.B. Fedorov[1], G. Schwamborn[2], D.Yu. Bolshiyanov[1], M.V. Pavlov[1], M. Melles[3], O. Juschus[3]
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By using complementary hydrological, geomorphological, and geological methods conclusions about the modern hydrology and Late Pleistocene to Holocene history of lake level changes and terrace formations of the meteoric crater Lake El`gygytgyn (Eastern Siberia) are drawn. It is shown that Lake El`gygytgyn´s level changes during its history are characterized not only by a gradual lowering but moreover by depending upon the global scale climate variability.

According to hydrological studies (1) the total sediment discharge of the lake appeared to be only slightly more than 1% of the total sediment input; (2) the sub-surface runoff plays an important role in the water balance of the lake, (3) the recent lake level changes have a slow regressive character mostly due to evaporation, (4) the period of the lake water exchange can be estimated to 120 years.

According to geomorphological studies Lake El`gygytgyn has four terraces – three above and one or even two below the modern lake level with the following ages: 35-40 m above lake level – Middle Pleistocene (MIS6); 10 m above lake level – Early Weichselian (MIS5.4 to 5.1); 8 m and possibly 10 m below lake level – Middle-Late Weichselian (MIS3 and 2); 3-5 m above lake level – Early-Middle Holocene.

Continuous tectonic movements in the Middle-Late Pleistocene and Holocene caused a southeastwards shifting of the lake but unlikely had greater influence on lake level changes and terrace formations directly. Only the accumulative or abrasive character of one terrace formation (now 10 m above lake level) is understood to be a result of tectonic control during the Late Pleistocene times.

LAND-SEA CONNECTIONS IN THE ARCTIC OCEAN: THE LENA DELTA

I. Fedorova[1], D. Bolshiyanov[2], J. Strelchenko[1], D. Nikels[1]
[1]St. Petersburg State University, Russia
[2] State Research Center – Arctic and Antarctic Research Institute, St. Petersburg, Russia

Variations of hydrological conditions in the Lena River Delta are foundational in river channel transformation. Considering the geochemical features of suspended matter and lakustrine sediment cores accounting natural annual runoff fluctuations of the area, allows to define paleohydrological conditions in the delta and to predict potential runoff redistribution in the future.

A period 4.3 kyr BP within which the prevailing sedimentation conditions in lakes changed from allochtonus to autochtonus, was defined on the base of the geochemical analysis results and samples dating from the settled sediment cores in lakes located on the first and second subplain terraces in Olenekskaya channel.

The character of redistribution of solid and liquid runoff in the delta can be defined on the base of the field hydrological observations in Lena river delta performed in the framework the project “Laptev Sea System”. According to the field observation results and mean annual data it was defined that the Sardah channel runoff increases and the Trofimovskaya channel runoff decreases. It was observed that the runoff redistribution in the channels differs during different water regime phases. Within the flood period the Bulkurskaya channel runoff is significant, but within the low-water period is almost absent.

Nowadays the simulation model of geochemical conditions and material transformation in the delta is being created on the base of the obtained results, hydraulic-morphometrical methods, and paleoclimate records with support of OSL’s grant. The possible changes of

hydrological features in the Lena River are planned to be studied basing on the positive trend of annual runoff.

ENRICHMENT OF AMMONIA OXIDIZERS FROM PERMAFROST

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Permafrost soils cover about a quarter of the Earth's land surface. The soils are continuously frozen throughout the year and only the active layer thaws near the surface during the short vegetation period. The microbial life in these extreme environments is influenced by extreme gradients of temperature and moisture. In this study, the active layer of terrestrial and marine permafrost sites as well as ice wedges from the Lena Delta and Laptev Sea in Siberia were investigated. Samples were characterized geochemically and used for selective enrichment of ammonia oxidizers at low temperature (6°C). Results obtained by MPN-counts and enrichment cultures showed that ammonia oxidizers were present in most of the marine and terrestrial samples. For classification of ammonia oxidizers, samples were analyzed by polyclonal antibodies against their key enzyme, the ammonia monooxygenase, by immunoblot and immunofluorescence labelling. Specific IF labelling of antibodies against the two subunits of the enzyme as well as the characteristic morphology of the cells enable a differentiation between the genera of ammonia oxidizers of the ß-Proteobacteria. Our results indicated the existence of lithoautotrophic ammonia oxidizers in permafrost soil, which are well adapted to the extreme environment.

NITRIFICATION IN PERMAFROST SOILS OF THE POLYGONAL TUNDRA IN SIBERIA

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Since artic wetland soils are the most important natural source of the climate relevant trace gas methane, many investigations focused on the microbial C-cycle of permafrost soils. But despite a close connection between C-cycle and N-cycle, the N-cycle is mostly unexplored.

In this study one important part of the microbial N-cycle, the nitrification was investigated. During nitrification ammonia is oxidized by chemolithoautotrophic nitrifiers, the ammonia and nitrite oxidizers, in two steps via nitrite to nitrate. In permafrost soils of the polygonal Siberian tundra these bacteria have to resist extreme gradients of temperature, moisture und high concentrations of inhibitory methane. In geochemical characterized soil samples of the active layers cell numbers of nitrifiers and potential activities of ammonia oxidizing bacteria were determined. Results obtained by MPN-counts showed that clearly higher cell numbers of ammonia oxidizers (4×10^3 cells g dw^{-1}) and activities (200 ng N-nitrite g dw^{-1} h^{-1}) were found in the upper part of the dryer polygon rims compared to the waterlogged polygon centres. Cell numbers and activities of ammonia oxidizers in the upper parts of the polygon rims correlated with extreme high enrichment of nitrate (27 µg N-nitrate g dw^{-1}) which was connected with low concentrations of methane. Summarizing, the results showed obvious differences of nitrification and nitrate enrichment in the polygonal Siberian tundra mostly depending on the water content of the soil layers and a possible adaptation of these organisms to the extreme environment of the arctic permafrost soils.

COMPOSITION OF METHANOGENIC ARCHAEAL COMMUNITIES IN PERMAFROST SOILS OF NORTHERN SIBERIA

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The microbial CH_4 production (methanogenesis) is one of the most prominent microbiological processes in wet terrestrial environments. During the anaerobic decomposition of complex organic matter, CH_4 is formed by using metabolism end products of bacteria involved in the anaerobic foodchain (e.g. H_2, CO_2, acetate, formate). Here we analyzed the community structure of methanogenic archaea in arctic tundra soils by PCR using a specific primer set following DGGE and sequencing of 16S rRNA gene fragments. For the investigation of the methanogenic community composition we took samples from three different sites: (i) a low centre polygon, (ii) a floodplain (both sampling sites are located on Samoylov Island, Lena Delta) and (iii) a thermoerosion valley (Cape Mammontovy Klyk, ca. 400 km northwest the Lena Delta). DNA was extracted directly from soil using a commercial kit. First results showed both differences and similarities in the community structure of the three habitats. The banding patterns display the diversity of the methanogenic archaea which was higher on Samoylov Island than at the sampling site of Mammontovy Klyk. It can be also seen that there are some methanogenic species that probably can be found at any of the sampling sites.

With increasing depth of the active layer, and thus decreasing temperature, the vertical profile of the microorganisms changed. However, the pattern also showed that some organisms were located both in the top layer and in the zone near the perennially frozen ground. Influence on the change of the methanogenic community could also have thawing-freezing processes or the variety of utilisable substrates.

MAIN RESULTS OF THE MARINE PERMAFROST DRILLING CAMPAIGN 2005 IN THE COASTAL ZONE OF THE WESTERN LAPTEV SEA

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Vast areas of the Arctic continental margins are covered by permafrost (perennial permafrost). Within the past sea regressions the extensive shallow shelf areas in the Arctic seas (especially adjacent to the Siberian region) were open and frozen to a great depth. Now with the transgressive cycle the relict continental permafrost remained mainly as sabaqueous. The submarine permafrost in the coastal-shelf zone of the Laptev Sea was registered in relatively shallow drilling profiles. By the math models of subaqueous permafrost distribution, developed within the last decade, the shelf zones of the Laptev and East-Siberian seas are in fact occupied by permafrost completely. There are submarine paleovalleys in Lena and Yana Rivers only which have open talik zones as the existing models evidence. According to these models in the Laptev Sea coastal zone the permafrost thickness varies from 400 to 1000 m. Seismo-acoustic investigations performed mainly in the open Laptev Sea, supplementing drilling and modelling, also suggest the existence of submarine permafrost. However, despite of the existence of rich indirect data on shelf permafrost, its parameters, evolution and distribution character in the coastal-shelf zone are not covered by data enough. In fact, only several drilling profiles 30-80 m depth recovered the presence of subaqueous permafrost under the bottom in the Laptev Sea directly near the coast.

In April 2005 the submarine permafrost was drilled in the western Laptev Sea on the project “Dynamics of Permafrost in the Laptev Sea” in the framework of the Russian-German cooperation.

A profile of 6 boreholes from the coast to 12 km to the sea was drilled near Mamontov Klyk cape, down to 80 m to study the roof parameters and upper horizons of permafrost. Temperature regime and salinity in boreholes were measured and lithologic geocryologic structure and geochemical features of pore water were defined by field research methods. The first results evidence the existence of relict continental permafrost in the coastal-shelf zone recovered by all submarine boreholes. 12 km off shore zone at 6 m depth the submarine permafrost roof was registered at 30m depth below the bottom. The temperature and salinity parameters of the bottom sediments in the studied region in the western Laptev Sea differ greatly from those in the central and eastern Laptev Sea. For example the permafrost temperature on the bottom of the furthest and deepest borehole occurred very high, about -1°C. This fact allows us to suspect large thickness and wide distribution of subaqueous perennial permafrost in the Laptev Sea region as it was considered earlier.

PERIGLACIAL LANDSCAPE DYNAMICS AND PERMAFROST DEGRADATION IN THE LENA-ANABAR COASTAL LOWLAND- APPLICATION OF LANDSAT-7 ETM+ DATA, A DIGITAL ELEVATION MODEL AND GIS ANALYSES

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Remains of the periglacial palaeo-shelf landscape are preserved in the Lena-Anabar coastal area of the region near Cape Mamontov Klyk. In that region, ice super-saturated permafrost deposits, so-called Ice Complexes, are found widely distributed. They formed during the Late Pleistocene, when NE-Siberia was dominated by strong continental climate and no extent glaciations occurred. These conditions supported the long-term continuous aggradation of permafrost.

The ice content of these deposits up to 160 weight-% (compared to dry mass) makes it very sensible for regional and global climatic changes. With the beginning of the Holocene warming, Ice Complex deposits were influenced by extensive surface subsidence due to ground ice thawing (thermokarst). Additionally, thermo-erosion evolved due to action of running water occurring at coastal, river or valley sites during the warm season. Both processes of permafrost degradation lead to massive remobilization of formerly frozen sediments and are an important factor in periglacial landscape dynamics. The release of organic carbon into the Laptev Sea and the atmosphere is connected to the processes of thermokarst and thermo-erosion is. Nowadays, a complex tundra landscape exists in the investigation area, composed of remnants of the Late Pleistocene accumulation plain (Yedoma) and Holocene thermokarst and thermo-erosional structures.

Remote sensing is an important instrument for up-scaling our field data. Our attempt is, to quantify periglacial landscape units in the investigated area in NE Siberia using Landsat-7 satellite data from 2000. A classification of these periglacial landscape resulted in 13 surface classes, mainly based on differences in vegetation, soil moisture and relief position..

About 78 % of the studied coastal plain was affected by permafrost degradation according to spatial analysis and quantitative determination of thermokarst and thermo-erosional structures within a GIS. Using digital elevation models, it is possible to calculate the volumes of the investigated features.

THE THERMAL RESPONSE OF THE LAPTEV SEA TO WIND, TEMPERATURE, AND OCEANIC FORCING

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Satellite observations document an overall downward trend in Arctic sea-ice extent and area since 1978. During the period from 1979-2004, which includes the three extreme minimum years 2002, 2003, and 2004, the September ice extend declined by 7.7 percent per decade. A changing ice regime also affects the transfer of energy across the ocean-ice-atmosphere interface. As an example an increased heat transfer to the shallow Siberian shelf seas because of warmer air temperatures and longer periods of open water and a consequently higher insolation might result in increased water temperatures and finally in the thawing of the submarine permafrost. Recent studies of the distribution of methane on the Siberian shelves assume that this mechanism has already led to increased methane seepages from marine sediments.

Although the thawing of the upper boundary of the submarine permafrost caused by rising seawater temperatures should have a significant effect on biogeochemical cycles and gas seepages, only few year-round data sets of the bottom water temperature of the shelve seas of the Siberian Arctic exist. For that reason we deployed two ocean observatories in the shallow south-eastern Laptev Sea (LS). Unfortunately most of the instruments could not be recovered, but the analysis of the data from the recovered instrumentation together with satellite observations gave new insight into the mechanisms and driving forces of the thermal regime of the LS.

It could be shown that the thermal response of the submarine permafrost in the LS to changes in wind, temperature and oceanic forcing strongly depends on the water depth. On the basis of this result the LS could be subdivided into three regions with different thermal regimes:

a) the inner shelf and the shallow shoals within the LS (< 20 m water depth) are characterized by a high seasonal temperature variability and a seasonal breakdown of the density stratification. Higher bottom water temperatures during summer and fall are followed by the formation of brine-enriched cold and saline bottom waters in winter. In this region warmer air temperatures and longer periods of open water can directly affect the stability of the submarine permafrost;

b.) the mid shelf (20-50 m water depth) in the eastern LS shows a strong and persistent density stratification. This stratification effected a weak response of the bottom water temperature to atmospheric processes and conserves the low bottom water temperatures that are sustained by the advection of cold brine enriched waters from the inner shelf and the shoals. A changing Arctic environment with more days of open water and increased wind forcing may result in a recurrent seasonal breakdown of the stratification and increased bottom water temperatures also on the mid shelf.

c.) The outer shelf (> 50 m water depth) exhibits a thermal regime similar to the mid-shelf regime, but an increased wind-driven upwelling of warmer "Atlantic water" might result in a southward shift of the northern boundary of the submarine permafrost. To study this process, two ocean observatories were deployed in 2005 in the northern Laptev Sea.

THE DYNAMICS OF PERMAFROST IN THE LAPTEV SEA REGION, RUSSIA

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Thick continuous permafrost developed on the large Siberian shelf areas during the Weichselian period due to the up to 120 m lower sea level and the exposure of these areas to cold temperatures. With the transgression at the beginning of the Holocene warming, complex processes of the interaction of sea water with the permafrost landscape occurred.

The transformation of terrestrial to submarine permafrost in the Laptev Sea region has been one of the major research interests during the last years within the framework of the Russian– German program "System Laptev Sea". Based on the experiences obtained through field and laboratory studies as well as mathematical simulations of the permafrost evolution during earlier phases of the "System Laptev Sea" project, special emphasis has been put on the transformation from onshore to offshore permafrost.

During the Late Pleistocene regression, ice-rich sediments of the so called ice complex (IC) were accumulated on the surface of the dried part of the shelf. The IC is still widespread on New Siberian Islands, coastal lowlands, and on some small islands (Moustakh, Makar, Shelonskie Islands), near the shore (within the Buor-Khaya and Yana Bays). Owing to a very high ice content (80–98 vol. %), the IC is very susceptible to climate warming. Before the transgression the wide land areas of the actual shelf showed a typical Arctic landscape with an Arctic desert ecosystem and partly tundra-steppe vegetation. The climate was highly continental with very cold winters and relatively warm summers.

About 13 kyr BP thermokarst started to destroy the IC both on the shelf and coastal lowlands. Thermokarst lakes and depressions were formed (11-11.5)-(9.5-8.5) kyr BP when the position of the shoreline was at the actual isobathes –60 -45 m. Thermokarst processes started before the submergence of the shelf by sea water with negative temperature. Due to the transgression thermokarst lakes and alases with a bottom level below the actual sea level particulary on the shallow part of the shelf (between isobath - 20 m and the recent shoreline) were transformed into thermokarst lagoons.

During the flooding of the shelf and the subsequent coastal erosion "terrestrial" permafrost started to interact with sea water partly resulting in degradation and thawing.

A major goal of the last period of the Laptev Sea System project was the study of permafrost- seawater interaction. This was planned to realize by drilling campaigns from the coast to the shallow sea (COAST I) and to the deeper part of the Laptev sea (TRANSDRIFT IX and X).

During the expedition LENA/ANABAR 2003 the coastal exposure of Cape Mamonov Klyk and its hinterland has been studied as an example of the Ice Complex not influenced by interaction with sea water. Intensive studies were undertaken by all relevant working groups of the project during the expedition and in the laboratories. The results obtained were the base for the studies of the frozen and unfrozen cores obtained during the expedition COAST I in spring 2005. Starting with a 60 m deep reference borehole on Cape Mamontov Klyk, five boreholes from 17 to 77 m deep were drilled from sea ice into the submarine deposits to a distance of 11.5 km from the coast. Complex sediment sequences were recovered representing partly typical Ice Complex permafrost and unfrozen sands with pore waters of higher salinity. The geocryological and geochemical studies of the core material will certainly bring some light in the history of submarine permafrost degradation.

Parallel to these studies, the role of microbial activity for carbon turnover during the degradation of permafrost is another important topic of the studies realized during the Laptev Sea Project.

TEMPERATURE REGIME OF THE TRANSITION ZONE FROM TERRESTRIAL TO SUB-SEA PERMAFROST AT MAMONTOVY KLYK / LAPTEV SEA

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The shores of the Siberian Laptev Sea show high rates of coastal retreat (up to 10 m/a). Especially the transition zone from terrestrial permafrost to relic sub-sea permafrost is an essential key-site for investigation and understanding of the processes involved during submergence. These processes, which have been going on since the end of the last glacial maximum, are vital to the assessment of sub-sea permafrost stability and distribution.

During COAST 1 expedition in april 2005 five shallow boreholes (up to 70 m depth) have been drilled along an 11 km long coastal transect. Temperature measurements in the

boreholes showed the temperature field which can be divided into three sections: 1. The terrestrial zone, where the permafrost temperature is strongly influenced by ambient air temperature. 2. A near shore zone, where the fast ice touches the seabed during winter months and zone 3. which is covered by sea water all-season. The exposure of frozen ground to the relatively warm the sea-water (approx. –1.5°C) during submergence forces a new thermal boundary condition upon the permafrost. Our measurements show, that the sub-sea permafrost equilibrates thermally very quickly with the overlying sea-water. At a distance of 2500 m off shore, which is equal to a time of submergence of 635 years B.P. (at a local rate of 4 m/a coastal retreat), the borehole temperatures have adopted to water temperature almost completely. Remaining temperature gradients are of magnitude -6 mK/m.

This implies that the relic sub-sea permafrost is close to its thermal stability conditions at -1.5°C throughout most of the Laptev Sea shelf. Therefore other stability factors e.g. porewater salinity of the frozen ground could make the difference between stability or degradation of the sub-sea permafrost.

PRELIMINARY RESULTS OF NEAR SHORE TEMPERATURE MEASUREMENTS IN BOREHOLES IN THE LAPTEV SEA DURING COAST I EXPEDITION

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During Coast I expedition in April 2005 within the Russian-German co-operation „System Laptev Sea“ five boreholes were drilled on an coastal transect in the western Laptev Sea (fig. 1) to examine the processes involved in transition from terrestrial to offshore permafrost by temperature measurements.

The drill-sites were close to a location named „Mamontovy Klyk“ and covered a profile length of approx. 11 km. The rate of coastal retreat in this area is about 4 m/yr, thus history of permafrost submergence can be very well examined in near shore boreholes.

Downhole temperature measurements were conducted to determine the transitional temperature field of near shore sub-sea permafrost. They were carried out by using a newly developed infrared temperature borehole tool. A special feature of this tool is a fast temperature response making it very suitable for dry boreholes.

In C-2, below a depth of 68 meters, unfrozen sediments were found. The existence of offshore permafrost underneath holocene marine sediments coincides with a minimum in temperature. The occurrence of unfrozen sediment is associated with an increase in temperature and possibly salinity.

LARGE-SCALE ATMOSPHERIC CIRCULATION OVER THE ARCTIC: IMPACT ON THERMAL REGIME OF THE CONTINENTAL SHELF OF THE LAPTEV AND EAST-SIBERIAN SEAS THROUGH THE BENTHIC ATLANTIC WATERS PENETRATION

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The Atlantic Waters (AW) inflowing to the Arctic basin through the Fram Strait and deep water channels in the north Kara Sea are the major heat source in the Arctic. AW distributing along the continental slope become colder, and the initial heat budget decreases. Large-scale atmospheric circulation over the Arctic can provide the further AW

flow toward the internal shelf regions. When different types of circulation regime prevail the direction of AW stream changes (It locates at 50-300 km distance from the shelf area boundary) and transports AW toward the open basin or toward the continental slope. In last case the relatively warmer and saltier waters may influence on thermal conditions in both the internal and external regions of the continental slope.

In this work the interaction between large-scale atmosphere circulation forms and hydrological regime of benthic layer of the Laptev and East-Siberian seas was studied. For this purpose the measurement data from more than 6500 summer and almost 3000 winter oceanographic stations over the Laptev and East-Siberian Sea shelves since 1948 were analyzed.

The evident difference of the benthic layer characteristics connected with the AW and Cold Halocline expansion into the internal shelf regions was registered. This difference is directly connected with atmosphere circulation regime and the local wind direction near the ground. In the region of submarine relict valley of the Lena Delta the warmer and saltier waters from the open basin impact on the region limited by 40 m isobath and located at 300 km distance from the continental slope boundary. In this case winds of eastern directions prevail, and there is the anticyclonic regime of atmosphere circulation northward the Novosibirskie Islands.

POSTGLACIAL ENVIRONMENTS IN THE LAPTEV SEA INFERRED FROM DINOFLAGELLATE CYST ASSEMBLAGES

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As a result of the last postglacial sea level rise the shallow Laptev Sea shelf was rapidly flooded. On the basis of dinoflagellate cyst assemblages records in 6 detail AMS C^{14} dated sediment cores obtained from the water depth between 21 and 270 m on the Laptev Sea shelf and the adjacent continental slope, major phases of sea-ice and hydrological change associated with postglacial sea-level rise were recognized in the eastern and western Laptev Sea for the last 11.3 cal. ka and 17.5 cal. ka correspondingly.

Until 11.3 cal. ka, the outer eastern Laptev Sea shelf (>51 m paleodepth) was rapidly inundated and paleoenvironmental conditions were characterized by high precipitation of river-loaded matter, primarily riverine plankton. For the purpose of reconstruction variations in riverine discharge we used the ratio between marine dinoflagellate cysts and freshwater chlorophyte algae (CD-ratio). The later one transported to the shelves by rivers can be used as indicator of river outflow. High CD-ratio values (up to 20) give evidence for estuarine conditions existed at the studied site (core PS51/135-4) between 11.3 and 10.3 cal. ka.

The following time interval 10.3-9.2 cal. ka on the outer eastern Laptev Sea shelf was marked by predominance of the dinocyst Operculodinium centrocarpum and Pentapharsodinium dalei. Their occurrence in the Laptev Sea indicates the inflow of relatively warm Atlantic waters along the Eurasian continental margin. The high relative abundances of these species in the outer Laptev Sea shelf was probably caused by enhanced influence of Atlantic water at the continental margin or decrease in sea ice cover and existing more favourable conditions for their growth in the Laptev Sea than the modern one. It confirms by significant increase of GP-ratio values.

According to our data modern-like environments on the outer eastern Laptev Sea shelf were reached around 8.6 cal. ka, and on the inner shelf around 7.4 cal. ka.

On the western Laptev Sea continental slope time interval 17.5-13.0 cal. ka was characterized by low dinocyst concentrations and predominance of euryhaline cold-water species such as *Islandinium minutum*, *Brigantedinium* sp., *Echinidinium karaense* and cyst of *Polykrikos* sp. Arctic morphotype. The increase in concentration of gonyaulacoid dinocyst species was marked out since 13.0 cal. ka. Relatively warm-water indicative species (*Spiniferites elongatus* and cyst of *Pentapharsodinium dalei*) occur in core sediments since approximately 10 cal. ka.

High CD-ratio values indicate strong influence of Khatanga river outflow to the studied site (core PS51/159-10, paleodepth 60 m) between 12.0 and 11.2 cal. ka. Pronounced changes in dinocyst assemblage composition between 11.2 and 7.0 cal. ka are characterized by a strong increase in total concentration and proportions of *Operculodinium centrocarpum* (up to 80%) along with the appearance of relatively warm water indicative species such as cyst of *Pentapharsodinium dalei*, *Spiniferites elongatus* and *Nematosphaeropsis labyrinthus,* and increase of GP-ratio values. This allow us to assume the relatively warm-water summer temperature, and possible reduction of sea-ice cover and enhanced influence of warm Atlantic water, that is in a good accordance with our records from the eastern Laptev Sea shelf.

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CRYOSTRUCTURES OF ICE COMPLEX SEQUENCES OF THE LENA DELTA

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Cryostructures of Ice Complex were studied in the framework of the Russian-German project "Laptev Sea System" in the Lena Delta on the remnants of Late Pleistocene polygenetic plain (Kurungnakh-Sise Island). Sampling was carried out on the base of the results of the permafrost drilling on different hypsometric levels and natural exposure (40 m). Analysis of cryostructures of main genetic and lithologyical types was supplemented by microstructural investigation of undestroyed monoliths of frozen sediment. Resemblance and differentiation of textures was studied in the different scales.

PERMAFROST SOILS OF THE LENA DELTA: PROPERTIES, GENESIS AND CLASSIFICATION

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Permafrost-affected soils, which cover nearly one fourth of the terrestrial surfaces in the northern hemisphere, play a major role in the global carbon cycle. About 14% of the global soil carbon is stored in permafrost soils and sediments. Spatial distribution and genesis of soil types in arctic tundra landscapes provide a necessary basis for process studies on climate-relevant trace gas fluxes and up-scaling approaches on the balance of the global carbon budget. In summer 2001, the permafrost-affected alluvial soils of Samoylov Island, a typical island of the Lena Delta, were described, analysed, mapped and classified according to different international soil classification systems.

Investigation Site Lena Delta: Largest delta in the Arctic (32,000 km2), 72°23' N, 126°29' E, arctic continental climate, mean temperature –10.2°C, mean precipitation 140 mm, continuous permafrost, river terraces and recent floodplains and subarctic tundra vegetation.

Landscape and Soil Units of Samoylov Island: The island has a size of 7.5 km2 and is composed of two geomorphological units. The western part (3.4 km^2) represents a modern floodplain, which is flooded annually in early summer by the Lena River. The floodplain is characterised by very diverse soil types: *Typic Psammorthels* were found on elevated sand ridges while *Typic Aquorthels*, *Ruptic-Histic Aquorthels* or *Fluvaquentic Fibristels* were developed in former river channels and depressed areas. The vegetation cover on wet sites is dominated by *Arctophila fulva, Eriophorum angusti-folium and Carex aquatilis* and on

dry sites of sandy ridges close to the beach by *Deschampsia caespitosa*, *Poa alpigena*, *Alopecurus alpinus and Tanacetum bipinnatum.*

The eastern part (4.1 km^2) is build up by sediments of a Late-Holocene river terrace and is only flooded in parts during extreme flooding events. It is characterised by polygonal-patterned ground with ice-wedge growth. A prominent microrelief is developed with depressed wet centre (*Carex aquatilis*, *Carex rariflora*, *Limprichtia revolvens*, *Meesia longiseta)* and elevated moist rim (*C. aquatilis*, *Dryas octopetala*, *Salix glauca*, *Hylocomium splendens).* The surface is composed of a mosaic of lakes and a soil complex of *Glacic Aquiturbels* (polygon rim: water level: 45 cm below soil surface, thaw depth: 47 cm , distinctly oxic in the top soil, reduced conditions below, ice wedge at 70 cm, cryoturbated) and *Typic Historthels* (polygon centre: high water level:5 cm below surface, thaw depth: 31 cm, waterlogged, predominantly reducing conditions, peat accumulation, dense root mat).

Conclusions: The permafrost soils of the Lena Delta are well characterized by the Soil Taxonomy (Gelisols) and the World Reference Base for Soil Resources (Cryosols). According to the new Russian Soil Classification System (Cryozems) the soils have to be classified as Alluvial soils (Entisols, US Soil Taxonomy) which is not satisfactory for the special soil-ecological permafrost-landscape of the Lena Delta. The older Russian classification takes into account the strong influence of cryogenic processes on the permafrost-affected soils of the delta. In general, an international accepted harmonisation between the different systems and the main diagnostic horizons should be developed. Such a classification system, based on a profile genesis with better defined qualitative and quantitative characteristics, could also be used for applied questions such as global carbon balance in the permafrost and trace gas fluxes in the Artic region.

INVESTIGATION AND UNIQUE FINDS OF LARGE GRAZING MAMMALS OF THE "MAMMOTH" FAUNA

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Abundance of grazing herbivores in high latitudes invites the assumption of some pasture ecosystems, essentially different from modern tundra. Study of fossil remains of mammals provides information about the past life and important proxy evidence for the reconstruction of past climate conditions. Combined with the traditional paleobotanical analysis and with a complex of sedimentological research, it forms the base for the most complete reconstruction of the past environment. Our investigations were focused on the study of members of the "Mammoth" fauna:

- morphological study and taxonomical determination of each sample of fossil animals (approximately 15 taxa of mammals);
- radiocarbon dating of bone, skin and hair (^{14}C; AMS);
- analysis of data on stable isotope ratios ($\delta^{18}O$, $\delta^{13}C$ and $\delta^{15}N$) on collagen of fossil bones;
- analysis of data on sequenced of mitochondrial DNA from woolly mammoths, horses, bison and others.

We gathered the unique collections of about 4000 mammal bones from the Laptev Sea Region: New Siberian Islands (Kotel'ny, New Siberia, Bol'shoy and Maly Lyakhovskye), Muostakh Island, Lena Delta Region (Bykovsky Peninsula, Olenyek Channel, Arynskaya Channel), Oyogos Lowland and Olenek-Anabar Region. All of the found fragments were registered and determined in order to obtain complete statistics of the species composition. Our radiocarbon database is one of the largest on mammals of "Mammoth" fauna. It contains more 300 dates and includes data on bones, skins, soft tissues, hair of woolly mammoth, hors, musk-ox, bison, woolly rhinoceros, saiga and others.

About 350 samples were analyzed stable isotope ratios ($\delta^{13}C$ and ™^{15}N) of grazing mammal bones and mammoth hear. Carbon and nitrogen isotope ratios in consumers are mainly determined by stable isotope composition of forage plants. Reconstructed average carbon isotope composition of plant of Bol'shoy Lyakhovsky Island about 28 Ka BP on

mammoth hair is close to the recent for the East Siberia Arctic (Nikolaev et al., 2003). In collaboration we investigate mitochondrial DNA from 32 wooly mammoth, 8 bison and 6 horses remains from our collections of "Mammoth" fauna.

Our investigations are carrying out during the Russian-German project "Laptev Sea System". We thank all German, and Russian colleagues who took part in the expeditions under the Project for their help. We are also thankful to Russian–German Otto Schmidt Laboratory and INTAS project 03-51-6682 for the support of these works.

CHARACTERIZATION OF NITRITE-OXIDIZING BACTERIA ENRICHED FROM PERMAFROST SOILS IN RESPONSE TO DIFFERENT GROWTH TEMPERATURES

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Nitrification is one of the key processes in the nitrogen cycle and provides the linkage between ammonia and nitrate. It is mediated by lithoautotrophic nitrifying bacteria and consists of the oxidation of ammonia to nitrite by ammonia-oxidizing bacteria (AOB) followed by the oxidation of nitrite to nitrate by nitrite-oxidizing bacteria (NOB). Nitrifying bacteria are well adapted to extreme conditions like low temperature, but only limited information is available regarding the distribution of such organisms in permafrost soils. The global climate change has been shown to enhance permafrost thawing and nitrifying bacteria viable in perennially frozen permafrost deposits become more involved in active biological processes. Nitrification is regarded to be one of the most important processes in functioning soil ecosystems due to the release of climate relevant nitrogen oxides. The aim of this work was to identify responsible NOB enriched from tundra and permafrost soils and to measure growth rates during long-term incubation at different temperatures.

To determine whether the community of NOB has been adapted to psychrophilic or psychrotrophic conditions we examined growth rates in a wide range of incubation temperatures. Enrichments from recent tundra soil and deep permafrost deposits were mostly found to be mesophilic with optimum growth temperature higher than 20°C, while samples from the upper permafrost revealed the presence of psychrotolerant nitrifiers with an optimum growth temperature of 17°C. Chemotaxonomic analysis of the fatty acids as well as molecular investigations of NOB revealed a high influence of the growth temperature on the community structure. Organisms enriched at 17°C were identified as representatives of *Nitrobacter* or *Nitrospira*, which prefer temperatures up to 28°C. At 4°C and 10°C they were displaced by a novel bacterium, differing from all terrestrial NOB known so far. Cold adaptation is realized by increasing the amount of unsaturated fatty acids. Further characterization of such organisms is in progress.

PEDOGENIC TRANSFORMATION OF CLAY MINERALS IN PERMAFROST-AFFECTED SOILS

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Cryosols of Russian European Arctic were studied on the example of Novaya Zemlya archipelago soils (Pankova land). The common processes for mineral matter pedotransformation are: redoximorphism, cryostructure formation, cryoturbation. Pedomorphic transformation of clay minerals of these soils is very weak. But it is possible to distinguish a set of properties that characterize this group of soils:

(1) the crystal structure of clay minerals became worse in the upper horizons of mature drained soils and especially in superficial litter horizons, as well as in the gleyic horizons; the mineral composition of clay-size fraction is changed weakly as a result of degradation of cation deficit mica and chlorite;

(2) the pedogenic, thermodynamically unstable iron oxide - lepidocrocite (γFeOOH) appears in gleyic horizons. Soils of Vaigach Island and Yugor peninsula are characterized by the strongest differentiation of the clay minerals due to the smectite phase accumulation in the middle part of solum (Zvereva, Ignatenko, 1983).

So, it is possible to propose a concept that there is an area in high latitudes where the pedotransformation of clay minerals is strongly impeded and close to nil due to extreme climatic conditions.

COLD LOVING METHANOTROPHIC COMMUNITIES IN PERMAFROST SOILS OF THE LENA DELTA, SIBERIA

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Wet tundra environments of the Siberian Artic are considerable natural sources of methane, a climate relevant trace gas. The Arctic is observed to warm more rapidly and to a greater extend than the rest of the earth surface. It is suggested, that the tundra in Alaska and Russia has changed from a net sink to a net source of atmospheric carbon. The potential impact on the Arctic carbon reservoirs is highly influenced by changes in microbial processes like methanogenesis and methane oxidation.

The process of methane oxidation is mainly controlled by methane oxidising bacteria (MOB). These obligatory aerobic bacteria determine the amount of methane that is released from Siberian permafrost soils. In Arctic environments, biological processes are controlled by seasonal freezing and thawing, which leads to an extreme temperature regime in the upper active layer of the permafrost. Therefore, methane oxidation rates were determined in dependence of the temperature via the conversion of $^{14}CH_4$ to $^{14}CO_2$. First results for samples of Samoylov Island (N 72°22, E 126°28, Lena Delta, Siberia) indicate a shift in the temperature optimum of the methanotrophic activity with soil depth. MOB in the upper soil layers appeared to have their highest activity at temperatures of 21 °C. Contrarily to that finding, in deeper horizons close to the permafrost table the maximum methane oxidation rates were determined at 4 °C. These results indicate the existence of specialised cold loving methanotrophic communities within the environment of Siberian permafrost soils.

Further research on the temperature-depending activity, the phylogenetic diversity as well as the dynamic and stability of the methanotrophic communities will be undertaken.

STUDIES OF GAS HYDRATES AND AUTHIGENIC CARBONATES FORMATION PROCESSES OFF NE SAKHALIN AS A BARRIER FOR FLUID VENTING

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Fluid infiltration is one of major process in the formation of gas hydrate accumulations. Gas hydrate accumulations are formed due to the two main types of fluid infiltration: dispersal and focused. Gas hydrates related to the focused type of infiltration obviously associated with fluid venting on the seafloor.

The area of focused fluid venting off NE Sakhalin (the Sea of Okhotsk) was investigated in August-October 2003 during the 31st and 32nd International expeditions of R/V „Akademik Lavrentyev“ in the framework of the CHAOS project. About 40 structures related to fluid discharge were discovered by acoustic and hydro-acoustic profiling. All the fluid vents were considered as potential gas hydrate accumulations. The geological coring

was carried out within three of them, named the "Chaos", the "Hieroglyph" and the "Kitami". Gas hydrates were sampled from all of them. Characteristic features of the recovered cores are numerous bivalves, authigenic carbonate nodules and concretions, (rudimentary in the upper parts of cores) cheese-like sediment structure caused by gas release, and strong H_2S odor.

These observations are important for the study of the role of gas hydrates in the global climate changes. The processes of gas hydrate dissociation in the lithosphere are to be studied, but this process may be converse. Our studies evidence the submarine gas hydrates formation and also the formation of authigenic carbonates are the geochemical barriers for hydrocarbon gas to emigrate from lithosphere to hydrosphere and atmosphere.

GEOCHEMICAL PROCESSES IN COASTAL AND OFFSHORE PERMAFROST

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During periods of low sea level, the Arctic shelf areas have been exposed to extremely low air temperatures and permafrost with a thickness of up to several hundred meters could develop. When sea levels rose during transgression and coastal erosion, the permafrost was submerged by relatively warm and saline seawater. It is assumed that today submarine permafrost covers an area of approximately 13 Mio km^2 of the Arctic shelves, mainly the Laptev, East Siberian and Southern Beaufort Seas.

The main research questions addressed in the present study are: How does the marine salt affect the stability and existence of the offshore permafrost? Which processes are taking place in the coastal area, i.e. the transition zone between onshore and offshore permafrost?

In spring 2005, during the expedition COAST I of the Russian-German Cooperation „System Laptev Sea", pore waters from marine boreholes have been obtained at Cape Mamontov Klyk, western Laptev Sea (73°36´N; 117°10´E). The study area offers a great opportunity to gain an understanding of the ongoing processes during the transformation of terrestrial permafrost and to apply the results to subsea permafrost in general.

Laboratory analyses of the pore water samples included hydrochemical analyses (major ions), salinity measurements and isotope composition. Besides temperatures in the boreholes have been measured during the expedition.

Preliminary results indicate that an unfrozen layer develops in the permafrost underneath the sea bed despite negative temperatures. Along the drilling profile the permafrost table declines seawards while the thickness of the unfrozen layer increases. In a distance of approximately 11.5 km off the coast the permafrost table has been located in a depth of 35 m already. Depth-salinity profiles show an interaction of the saline seawater with the underlying permafrost. Above the permafrost table salinity is high, the table itself is characterized by a sudden decline of salinity. In the adjacent meters an influence of salinity can still be observed. The furthermost borehole off the coast, where the permafrost table is in a depth of about 35 m, shows a decline in salinity already above the permafrost table. A possible explanation could be the melting of the freshwater ice in the permafrost, which would result in a decrease of salinity. In the lower part of this core, from 64 m downwards, unfrozen sediments were found, which possibly result from increasing salinity originating from ancient marine sediments. It is not clear yet if here the lower boundary of the permafrost has been reached or if unfrozen layers or lenses are present within the permafrost as a consequence to higher salinity of the pore water.

The results of the isotope analyses (δD= -244.6 to -207.8 ‰, $\delta^{18}O$= -31.03 to –26.65 ‰) show a composition of meteoric origin, which is a clear evidence for the terrestrial genesis of the studied permafrost. The light isotopic composition in the lower parts of the studied cores refers to cold climatic conditions, most probably they originate in the

Pleistocene. The general characteristics of the subsea permafrost observed in all cores are very similar to that of onshore permafrost sequences which points to a similar genesis.

The consideration of the time elapsed since submergence and the understanding of the ongoing processes will significantly help to improve our knowledge of the temporal and spatial evolution of submarine permafrost on the Arctic shelves as a whole.

THE LATE QUATERNARY GROUND ICE AT CAPE MAMONTOV KLYK – PALAEOCLIMATE ARCHIVE AND TERRESTRIAL ENDMEMBER OF THE COAST DRILLING CAMPAIGN

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Research at Cape Mamontov Klyk, Northern Siberia, was carried out to reconstruct the palaeoclimatic and palaeoenvironmental history in this remote region. The investigated area is located in the Lena-Anabar lowland at the Laptev Sea coast, and it is the westernmost region visited during the System Laptev Sea Project. Generally, the cliff of Cape Mamontov Klyk (73°36' N; 117°10' E) consists of ice-rich sediments with a complicated depositionary and cryolithological situation. This coastal outcrop serves as "terrestrial endmember" for the interpretation of the submarine permafrost cores taken during the COAST drilling campaign in spring 2005.

Four units outcropping at cliff Mamontov Klyk can be distinguished based on the sedimentological parameters. (1) Bottom sands with ice-sand-wedges represent the oldest unit in this section (IRSL dated between 31 and 56 ka), overlain by (2) a peat-sand-complex with small ice wedges radiocarbon dated to 35-45 ka ^{14}C BP. Above that the (3) Late Pleistocene Ice Complex (35-28 ka ^{14}C BP) characterised by silty sands with huge syngenetic ice wedges. The Ice Complex is partly covered by (4a) a 2 m thick horizon of peat-rich, silty sediments of Holocene age. Besides this, two more subunits of Holocene age can be distinguished: (4b) deposits of thermoerosional valleys as well as (4c) fluvial deposits. First interpretations of these units indicate changing depositionary conditions from a rather fluvial to an alluvial environment in the Pleistocene and its thermoerosional destruction in the Holocene. Sediment and ground ice (ice wedges and texture ice) of all these units were sampled over the whole vertical profile of the cliff for isotope geochemical analyses.

Ice wedge are mainly formed frost cracking and refreezing of melt water of winter snow, thus, the isotopic signal of an ice wedge is indicative for winter temperatures. Recent ice wedges show that today's climate seems to be the warmest for that area with the heaviest isotopic composition of all ice wedges at Cape Mamontov Klyk. Winter conditions during the Holocene were slightly colder than today. The Pleistocene ice wedges, however, show a clear transition in the isotopic compositions, which separate them clearly from the Holocene units (~ 5 ‰ in δ^{18}O less) pointing to colder winter temperatures at that time. The peat-sand-complex shows extreme variations in the isotopic composition. It remains uncertain if these variations can be explained by fluctuations in the winter temperatures only. Bottom sands reflect a period characterised by cold temperatures and low climatic variability in the winter season.

In contrast, texture ice is generally assumed as a mixture of summer and winter precipitation and isotope variations within a sediment column are more difficult to explain. Various processes such as seasonality of precipitation, amount of rain and snow feeding the active layer, fractionation during melting and freezing may influence its isotopic composition. Nonetheless, the isotopic compositions of both texture and wedge ice in the COAST cores point to old permafrost being in comparable range to their analogues at Cape Mamontov Klyk. This is the first time old submarine permafrost has been proven by isotope methods.

PALEORECORDS OF HYDROGRAPHICAL CHANGE AND SIBERIAN LAND-SHELF CONNECTION ON ANNUAL TIMESCALES

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It is now widely accepted that changes in surface ocean hydrology at northern high latitudes is a major forcing mechanism that can strongly perturbate a particular climate mode. Given the variability on subdecadal and on centennial to millennial timescales, the dispersal and fate of arctic riverine water discharge and its role on the ice regime as well as on surface water properties are central issues in the understanding of Holocene climate change in the arctic marginal seas, the Arctic Ocean, and beyond.

Oxygen isotope profiles from living and fossil bivalves were investigated in order to trace modern and past hydrographical changes in the strongly coupled land-shelf system of the Laptev Sea. Detailed oxygen isotope measurements were executed on the shells along their axis of maximum growth and provide an isotopic record of hydrological and environmental changes for the lifespan of the individual bivalves. The oxygen isotopic records exhibit amplitude cycles interpreted as recording annual cycles. Based on the well-known relationship between the oxygen isotope ratio in the bivalves carbonate, the temperature and the isotopic composition of water, it is possible to relate phases of more negative (lighter) oxygen isotope values indicating summer and more posi-tive (heavier) oxygen isotope values indicating the winter season.

The main forcing factor of the oxygen isotope variations is the variability of the isotopic composition of the bottom water. Measurements of the oxygen isotope ratio in surface and bottom waters of the Laptev Sea show a linear relation of salinity and oxygen isotope ratio of the water with a coefficient of 0.50 per mill per salinity unit and document the mixing of freshwater and seawater. The oxygen isotope cycles from growing profiles of the living bivalves indicate a correspondence to seasonal hydrographic changes and can be compared with runoff data and circulation patterns in the Laptev Sea. Given the seasonal cycles in living bivalves, oxygen isotope profiles of fossil, radiocarbon-dated, and well-preserved bivalve shells from sediment cores are used to reconstruct the Holocene variability of riverine runoff from the North Siberian margin into the Arctic Ocean.

THE RESEARCH RESULTS OF HYDROCHEMICAL INVESTIGATIONS IN THE LAPTEV SEA FROM 1993 TILL 2005

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Hydrochemical characteristics of seawater are the links between physical, biological and biogeochemical processes. The knowledge of hydrochemical regime is a key to study of nutrient fluxes, CO_2 exchange between ocean and atmosphere, biological cycles and important element at the selection of water masses and study of their variability in the open to injury Arctic ecosystems.

The international cooperation under the scope of German-Russian Laptev Sea project allowed us to collect the modern high quality data base (more than 10 expeditions, about 400 stations), to find the answers about the peculiarity of distribution and interannual variability of hydrochemical parameters, to create new methods of numeric evaluations of phosphate, nitrogen and carbon fluxes and to estimate CO_2 fluxes. It allowed us to publish

new papers, make presentations at the international conferences and handbooks of hydrochemistry of Arctic Seas.

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INVESTIGATIONS OF DINOFLAGELLATE CYST ASSEMBLAGES IN THE WHITE SEA SEDIMENTS

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Modern research methods of the arctic marine sediments enable us to use a big group of biogenic particles, called palynomorphs for stratigraphical and paleogeographical investigations. Dinoflagellates are the one of the leading group of the phytoplankton of the White Sea and one of the most important constituent of aquatic palynomorphs assemblage (Semina, Sergeeva, 1983; Sergeeva, 1991; Ratykova, 2000 a,b, Polyakova et al., 2003). Study of the dinoflagellate cysts as well as their relation in the sediment with the green algae can give important informationabout the changes in river runoff, paleo salinity and ice regime of the White Sea in the past, as it has already been done for other Arctic seas (Kunz-Pirrung, 1999; Matthiessen et al., 2000).

Aquatic palynomorph assemblages from the surface sediments of the White Sea are composed of various organic-walled microfossils: dinoflagellate cysts, chlorococcalean algae, acritarchs and several groups of zoomorphs. Species composition and distribution patterns of dinoflagellate cysts and chlorococcalean algae are related to salinity gradient of the surface water and permanent currents. Dinocysts dominated in surface aquatic palynomorph assemblages are characterized by high proportions of predominantly subpolar species *Islandinium minutum*, *Operculodinium centrocarpum* and *Brigantedinium.* sp. Two types of dinocyst assemblages were established in the White Sea surface sediments: "cold-water" protoperidinioid species (*Islandinium minutum, Islandinium cezare, Spiniferites elongatus*) and other cosmopolitan assemblages represented by gonyaulacoid specias *Operculodinium centrocarpum, Spiniferites ramosus, and Bitectatodinium tepikiense.*

Dinoflagellate cyst analysis also has been used in short sediment core from the central part of the White Sea to reconstruct hydrographic changes during past 250 year. As revealed by chronology data (Aliev et al., 2004), core 4719 from the outer part of Kandalaksha Bay (water depth 277 m) mainly covers the time between nowdays and 1750 year. According to radiochronology and fluctuation of relative abundance of "warm-water" species in aquatic palynomorphs assemblages compositions this period divided into several climatic intervals.

Species composition was compared with modern situation and have shown that the ratio of gonyaulacoid to protoperidinioid cysts (G:P) (Mudie at al., 2001) have strong tendency of general increase upcore till the end of 20 century, and indicates generally decrease of sea-ice cover in the White sea region.

Results of palynomorph study from the surface sediments of the White Sea reveal the following main features of their composition: (i) predominance of dinoflagellate cyst in the surface sediments (in total concentration (22000 cyst/g) and relative abundances in palynomorph assemblages); (ii) relatively low concentration of chlorococcalean algae, which are mainly related to the freshened bays; (iii) high total concentration and percentages of gonuaulacoid species of Atlantic Ocean origin indicating the extensive influence of Atlantic waters on the White Sea hydrology, and the favorable conditions for their habitat; (iiii) Distribution patterns of dinocyst assemblages in core sediments give evidence for hydrographic changes during past 250 year which are caused by climatic fluctuations in the Arctic; (iiii) Modern aquatic palynomorph data from the surface sediments of the White Sea proves the proxy tool for paleoenvironmental reconstructions.

SOURCES, PATHWAYS AND TRANSFORMATION OF NUTRIENTS IN THE LAPTEV SEA

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The arctic marine ecosystems are very sensitive to the environmental changes. Nutrients are the mineral base of primary production. To develop the scientific base for the nature-conservative measures it is necessary to know the main patterns of biohydrochemical parameters distribution and their natural variability.

There are many factors and mechanisms which influence the nutrients distribution and fate in the shelf Siberian seas. They are the river runoff and the processes in the river plume area, coastal erosion, ice formation and ice melting, interaction with the bottom sediments. From the other hand these are meteorological processes, storms, predominant winds, which form current structure. The main among them is the interaction with the Arctic basin, the river runoff and the influence of the ice cover.

The comparative analysis of different factors contribution in nutrients balance is presented for the Laptev Sea. The main features of hydrochemical structure of the sea are considered at the example of the transect 75°30' N. The processes influencing the hydrochemical structure of the Laptev Sea are presented. The new results of hydrochemical investigations obtained in the northern part of the sea are reported.

LITTLE ICE AGE FEATURES INFERRED FROM LAKE SEDIMENTS OF THE RUSSIAN ARCTIC

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The temporary frameworks of Little Ice Age were determined as a result of works under OSL grant in 2004. The basement for studying is lake sediments of Russian Arctic (regions: Polar Urals, Taimyr, Lena Delta, Putorana plateau). The northwest of Russia is included in the following works of the department Geography of Polar Regions in AARI.

Basic Little Ice Age feature is non-synchronous of beginning and the ending of last millennium cooling in various regions of Arctic regions. Duration of LIA was estimated about 450-500 years. LIA had the warm phase, continued about 100 years. The LIA cooling is marked by changing of spore-pollen spectra in lake sediments that testified about shifting of vegetation zones. As a result of the cooling some (a specially mountain) lakes were covered during summer time, which was accompanied by hydrological mode changing of the lakes.

The different methods of modern paleogeography were used: spore-pollen, diatom, geochemical and other. The chronological analysis of varves and the radiocarbon method have been used age determination.

GENESIS AND POSSIBLE SOURCES OF COVER SEDIMENTS OF DISPERSED ORGANIC MATTER IN AMERASIAN SHELF OF THE ARCTIC OCEAN

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The composition and distribution analysis of dispersed organic matter (DOM) of quaternary bottom sediments of Amerasian basin of the Arctic Ocean was carried out by data from expeditions onboard RV "Akademik Fedorov" (2004, 2005).

Lihological and mineralogical data of the sediments sampled in the Mendeleev Ridge region evidence the relatively stable accumulation of pelites in depressions mostly owing to sedimentation of slurry.

Corbonate carbon content in sediments vary significantly from 0,02 to 3,99 % what is higher than dispersion and absolute values of those parameters for shelf sediments of the eastern Arctic region. On sublatitudinal profile a range of the regular maximums of carbonate carbone content are observed in stratigraphic section.

Organic carbon (Corg) distribution in sediment section of sublattitudinal profile does not correlate with carbonate content and occurs due to low speed of sedimentation, insufficient inflow of initial organic material and\or high degree of its transformation. Organic carbon content, which does not exceed 0,25% in the upper horizons, sharply decreases at the first cm of the sediment section decreasing almost up to trace concentrations (0,10-0,01%) evidencing the reflection of drastic diagenetic loss of organic matter.

Norg content in the sediment section of sublatitudinal profile in average is 0,05%. Such low values are characteristic for abyssal areas of the Pacific and Atlantic oceans and evidence the high level of initial OM transformation. The C/N ratio for all studied samples is characterized by very low values (1,3-5,3).

Low concentration of chlorophyll in the water samples (less than 0,1 mkg/l) evidence the low initial bioproductivity in this region and suspects the possibility of hydrobionthic origination of OM to be the key aspect.

Thus the investigations carried out reveal the uniqueness of compositional content of organic matter of friable sediments on Mendeleev Rise caused by dominant role of strongly transformed material in the sediment formation.

GEOMICROBIOLOGICAL PROCESSES IN SOILS AND SEDIMENTS OF THE SIBERIAN PERMAFROST: RESULTS AND PERSPECTIVES

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Biogeochemical processes in permafrost environments are controlled by microorganisms. Investigations on the importance of microorganisms for the C- and N-cycle are focused on the processes of methane production, methane oxidation, and nitrification. Differences in microbial communities of terrestrial and marine habitats reflect permafrost dynamics. Objective is the prediction of permafrost development in dependence on climate change. The function of microorganisms for biogeochemical processes in permafrost was investigated by modern methods of microbiology and molecular biology. Different permafrost habitats were investigated during several expeditions 2003 -2005: i) Mamontovy Klyk, terrestrial permafrost sediments/ recent soils, ii) Laptev-Sea, Transdrift IX, marine sediments and iii) Lena Delta, recent soils. Main Results can be summarized as follows:

Methane production: The microbial diversity studies showed an adaptation of the methanogenic community to the different environmental conditions in permafrost soils and sediments. The archaeal biomarker studies gave first evidence of recent methanogenesis in perennially frozen Holocene permafrost deposits. The photosynthetically active radiation and soil temperature were identified as the most important meteorological controls on carbon dioxide and methane fluxes.

Methane oxidizing bacteria from perennially frozen sediments and paleosoils can be reactivated after thawing of permafrost. Viable methane oxidizers were found in habitats that were frozen for 2,000 to 40,000 years. The sizes of methane oxidizing communities in these materials are similar to those in deeper parts of the active layer, directly above the permafrost table. Methane oxidizing bacteria responsed to changing environmental conditions by altering their community structure.

N-cycle in permafrost affected soils was investigated focussing on nitrification. The functioning of ammonia and nitrite oxidation in dependence on different soil parameters was revealed by potential activity tests. New species of *Nitrosomonas, Nitrobacter* and

Nitrospira could be selectively enriched and characterized by molecular, immunological and chemotaxonomic methods. Ammonia and nitrite oxidizing bacteria are well adapted to low nutrient availability and remained active in ancient permafrost deposits. During long-term incubation at low temperature, a change in the community structure of nitrite oxidizers became obvious. Here, a novel psychrotrophic bacterium was detected, which might act as indicator organism for nitrite oxidation in permafrost sediments.

Perspectives: The geomicrobiological investigation – until now focused on terrestrial permafrost sites – show that the microbial methods could be adapted to the specific permafrost conditions and are suitable for future research on the impact of microbial processes on the dynamic and degradation of the permafrost. Investigations should be extended on the response of deeper permafrost sediments (terrestrial, submarine) on environmental changes. Future investigations on the N-cycle should also consider denitrification (N_2O fluxes). The data are necessary for the balance on the strength of important CH_4 and N_2O source and sinks in permafrost under changing climate conditions.

POSTGLACIAL EVOLUTION OF MARINE AND TERRESTRIAL ENVIRONMENTS IN THE LAPTEV SEA REGION DEDUCED FROM MICROFOSSIL ASSEMBLAGES

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In the scope of the OSL Fellowship program (OSL-05-24) we carried out investigations of recent and fossil diatom, aquatic palynomorphs, and spore-and-pollen assemblages from the Laptev Sea sediments dating back to approximately 17.5 cal. ka. According to changes in the species composition the following major events in the development of paleoenvironmental conditions were established: between 11.3 and 10.3 cal. ka the eastern Laptev Sea shelf was rapidly inundated and paleoenvironmental conditions were characterized by high precipitation of river-loaded matter, primarily riverine plankton. The following time interval 10.3 – 9.2 cal. ka on the outer shelf was marked by predominance of the Atlantic-water dinocyst species. The high relative abundances of these species as well as appearance of relatively warm-water indicative species in the outer Laptev Sea shelf was probably caused by enhanced influence of Atlantic water at the continental margin or decrease in sea ice cover and existing more favourable conditions for their growth in the Laptev Sea than the modern one. 8,9 – 8,5 cal. ka. the shallow inner Laptev Sea shelf was inundated. High abundances of freshwater algae give evidence for zone of marginal filter of Lena river at the time 8.6 - 8.8 cal. ka. at the depth 32 m. According to our data modern-like environments on the outer eastern Laptev Sea shelf were reached around 8.6 cal. ka, on the inner shelf around 7.4 cal. ka.

Pollen data from cores sediments give evidences for development of modern like conditions on the adjacent hinterland during the last approximately 6 cal. ka.

Reconstructed surface water salinities using freshwater diatoms as a proxy provide evidence for a salinity range between 11 and 15 during the last 6 cal. ka, which reflects temporal changes in the Lena River outflow. These changes may be interpreted as a result of variation in the Lena River runoff connected to climate fluctuations or as a result of channel migration within the delta. Discrepancy in the tendency of salinity fluctuations between the eastern and northern Laptev Sea shelf regions adjacent to the Lena Delta allows us to assume an increase in the Lena River outflow eastward via the Trofimovskaya or Bykovskaya Channels during the time between 4.2 and 2.8 cal. ka BP. At the same time, the increase in water salinities observed northward of the Lena Delta during this time interval provide evidence for the decrease in Lena River outflow northwards via the Tumatskaya Channel.

On the western Laptev Sea continental slope time interval 17.5 – 13.3 cal. ka was characterized by low dinocyst concentrations and predominance of euryhaline cold-water species. According to our data the outer western Laptev Sea shelf (60 m depth) was already inundated around 12 cal. ka. Relatively warm-water indicative species occur in core sediments since approximately 13.3 cal. ka. on the continental slope and 11.2 cal. ka. on the outer shelf. Pronounced changes in dinocyst assemblage composition between 11.2

and 6.5 cal. ka are characterized by a strong increase in total concentration and proportions of Atlantic-water species along with the appearance of relatively warm water indicative species. This allows us to assume the relatively warm-water summer temperature and enhanced influence of warm Atlantic water. Since 7.0 cal. ka. influence of relatively warm Atlantic water in the Laptev Sea strongly decreased.

LATE GLACIAL AND HOLOCENE POLLEN RECORDS FROM THE LAPTEV SEA CORES AND TERRESTRIAL SECTION MAMONTOV KLYK CAPE

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To establish the vegetation history of the Late Pleistocene and Holocene period in the Arctic Siberia 4 sediment cores, obtained from the Laptev Sea shelf and the adjacent continental slope the section from the Mamontov Klyk Cape (MAK) from the north of Middle Siberia were analyzed in terms of pollen, spores and palynomorphs content. According to the detailed radiocarbon (AMS) dating the studied cores encompass the last approximately 16 cal. ka, and studied upper part of MAK section covers the age from ~ 16 cal. ka.

Late Glacial transition from Younger Dryas severe conditions to the Holocene warming was recorded in the Laptev Sea cores from the western part of the sea (PS-51-159-10, PS-51-154-11). Preliminary pollen records from the cores of the eastern part of the Laptev Sea (PS-51-080-13, PS-51-092-12) cover the Holocene period of vegetation history, and allow us to observe the variations in pollen transport mechanisms form the land to the sea, variations in pollen concentration and its explanation, wind circulations, etc. Preliminary pollen results from MAK section (Lena Delta) for the last 16 cal. ka along with on-going study of other pollen specta from the New Siberian Islands allow us to make an appropriate correlation of the marine-terrestrial pollen records, therefore to the investigate closer the land-ocean interaction mechanisms.

THE HIGH RESOLUTION ACOUSTIC SOUNDING TECHNIQUE AS ONE OF THE POSSIBLE BASEMENTS FOR THE OFFSHORE PERMAFROST STUDYING

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The occurrence of the wide spread offshore permafrost at the vast and shallow areas of the Siberian Arctic seas could be consider as one of the most powerful relief forming and relief transforming factor during last transgression. The Laptev and Kara Sea shoal areas are the key locations for understanding permafrost evolution process, its rate and variability under different climatic condition. The Laptev and Kara Seas shelves show the number of the different marine key sites where the occurrence of the submarine permafrost at first has been predicted by mean of direct geological onshore investigation as well by mean of mathematical modelling and subsequently prove by mean both the seismic and drilling methods.

During several years, VNIIOkeangeologia is producing and modifying the high-resolution seismic equipment suitable for studying offshore permafrost as well as the technique for its application.

Since 2000 we studied several key-sites in Kara, Barents and Laptev Seas in terms of revealing the offshore and near-shore permafrost distribution by means of the mentioned equipment and technique. Our results show the distinct seismic interface in the sediment depth of 0-50 m with uneven surface, which can be identified as acoustic permafrost table. In a few places in Kara Sea, these conclusions have been verified by drilling data that proves the efficiency and reliability of said techniques.

Thus, the data obtained shows that the high-resolution acoustic sounding may be considered as an effective and cheap method for mapping the submarine permafrost in the shallow water. However these investigations require further geological and drilling study in order to monitor the ongoing processes, both in onshore and offshore conditions.

The investigations were supported by the "Arctic Coastal Dynamics" project (INTAS grant № 2329), "System Laptev sea Permafrost" funding by BMBF German Ministery of Education and Science (grant 03G0589D) and INTAS grant "Arctic environments: The protected areas of the Lena Delta and New Siberian islands – past and present development" (INTAS ref. 03-51-6682)

HIGH-RESOLUTION SEISMIC APPROACH FOR THE OFFSHORE PERMAFROST IDENTIFICATION

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During the glaciation epochs of the Pleistocene, permafrost developed over large areas of the Russian Arctic shelf. It can be expected that this fact had and still has a strong influence on global climate change.

While the mechanism of formation of the permafrost in terrestrial conditions is well known, its further evolution under the sea bottom is poorly understood. There are at least two different approaches. One group of researchers, studying the offshore permafrost by means of extrapolation and mathematical simulation, supposes that the permafrost is widespread on the shelf down to 50-60 m depth, while another group, who works on onshore and nearshore drilling data, assumes that permafrost is not to be expected at a distance of several kilometers from the coastline. Moreover, a number of papers have been published recently that advocate the subaqueous freezing of the deposits covering the permafrost and, hence, the subsea formation of permafrost. Finally, the offshore drilling data obtained in 2000 during the R/V "Kimberlit" cruise showed the subaqual genesis of the ice bonds occurring in the core samples. This adds to the general confusion about the mechanisms of growth and decrease of submarine permafrost and its behavior at present. In contrast to terrestrial permafrost, offshore permafrost is difficult to study with conventional geological methods, such as drilling or sampling. In this respect, an integrated approach uniting the high-resolution acoustic, seismic and side scan sonar techniques in terms of detailed studies of the preservation state of permafrost in nearshore and offshore zones may prove a promising method.

For several years, VNIIO has produced and modified high-resolution seismic equipment suitable for studying offshore permafrost as well as techniques for its application. Since 2000 we have studied several key-sites in the Kara, Barents and Laptev seas with respect to revealing the offshore and near-shore permafrost distribution by means of the mentioned equipment and techniques. Our results show a distinct seismic interface in the sediment depth of 0-50 m with an uneven surface, which can be identified as the acoustic permafrost table. In a few places in the Kara Sea, these conclusions have been verified by drilling dat,a which proves the efficiency and reliability of the mentioned techniques.

TRACE GAS FLUX MEASUREMENTS ON SAMOYLOV ISLAND, LENA DELTA

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Arctic tundra ecosystems have been major carbon sinks throughout the Holocene. However, during the past decades high latitude environments have been observed to warm faster and to a greater extend than lower latitudes. It remains unclear whether this warming trend will cause tundra ecosystems to become a net carbon source or whether changes in the ecosystems will offset possible increased carbon emissions. In order to investigate and address this uncertainty, landscape scale measurements of carbon exchange are necessary in different arctic ecosystems.

Within the joint Russian-German project "System Laptev Sea 2000" eddy correlation measurements of carbon dioxide, methane, and energy exchange were carried out during a period of 41 days in 2005 in northern Siberian wet polygonal tundra. For detailed understanding of the underlying biological and soil-physical processes, closed chamber flux measurements of both carbon dioxide and methane were also conducted during the same period. The study site was located in the zone of continuous permafrost on Samoylov Island in the southern part of the Lena River Delta. The area is characterized by arctic continental climate with very low temperatures and low precipitation. The mean annual temperature is -10.2°C and the mean annual precipitation is 140 mm.

Photosynthetically active radiation (*PAR*) and soil temperature $T_{soil\text{-}0.01}$ at 0.01 m depth were identified as the most important meteorological controls on carbon dioxide fluxes. As first preliminary results of the 2005 measurements campaign we present modeled ecosystem respiration (R_{eco}) and canopy gross photosynthesis (P_{gross}) time series, as well as net ecosystem exchange (*NEE*) time series, which were filtered and gap-filled by combining the empirical models for R_{eco} and P_{gross}.

THE LATE QUATERNARY HISTORY OF PERMAFROST LANDSCAPES IN THE WESTERN LAPTEV SEA COASTAL PLAIN

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The temporal and spatial dynamics of terrestrial permafrost were studied around Cape Mamontov Klyk for the characterisation of environmental changes in the western Laptev Sea lowland during the Late Pleistocene and Holocene. We extensively analysed permafrost coastal exposures in terms of cryolithology, geochronology and sedimentology. Additionally, we characterised and classified the complex periglacial coastal lowland using remote sensing data and digital terrain models.

The local permafrost sequences represent several accumulation stages of the last 50,000 years as well as strong facies changes. The observed sequence starts with 4 m thick fluvial bottom sands of infinite radiocarbon ages (> 37.1 ky BP, > 44.5 ky BP) and IR-OSL ages (quartz) of 30 to 60 ky. These fluvial sands are overlain by 5 m thick sand-peat alternations that represent a fluvial floodplain facies. The main part of the coastal cliff consists of 10-20 m thick ice-rich deposits of the so-called Ice Complex sequence, which is radiocarbon-dated between 27.2 and 14.5 ky BP (17 ky cal BP). The wide grain size distribution and bad sorting of the Ice Complex sediment samples are in contrast to the narrow grain size frequency curves of well-sorted fluvial deposits. The high contents of segregated ice and organic carbon indicate the intensification of soil formation. The upper part, correlating with the LGM-period, is characterized by stable low TOC values. Above the Ice Complex, Holocene deposits (10.7 to 2.9 ky cal BP) occur in small initial thermokarst depressions. Additional Late Pleistocene to Holocene deposits was studied in large thermokarst depressions (20.7 to 4.1 ky cal BP) and in thermo-erosional valleys (13.2 to 4.2 ky cal BP). Together with the yedoma uplands (i.e. erosional remnants of the Late Pleistocene Ice

Complex aggradation), these structures of permafrost degradation characterise the extensive coastal plain in front of the Pronchishchev Ridge.

Spatial analysis of the region revealed that thermokarst, thermo-erosion and related slope processes affect 78 % (that is, 1807 km^2) of the study area. This high value clarifies the significance of Holocene thermokarst processes for landscape dynamics in Arctic lowlands and the importance of considering permafrost degradation under current global change scenarios. Permafrost degradation directly influenced the palaeo-geography by changing the palaeo-hydrology from a regional regime with loosely distributed lateral runoff in a gentle Late Pleistocene accumulation plain far from the coast to a locally organized hydrological system with runoff towards numerous thermokarst depressions, thermo-erosional valleys, and river valleys in a Holocene coastal plain. Terrain types are not evenly distributed in the investigated region, indicating a directed environmental forcing. Permafrost degradation terrain increases from south to north on the northward inclined coastal plain. The non-degraded Late Pleistocene terrain surface of the yedoma uplands is more abundant in the south near the hills.

STRUCTURE OF LATE QUARTERNARY SEDIMENTS AND SUBMARINE PERMAFROST IN THE LAPTEV SEA – RESULTS FROM MULTICHANNEL SEISMIC SURVEY DURING EXPEDITION TRANSDRIFT X

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Beneath the Laptev Sea, a thick permafrost layer has developed during the last glacials since the now flooded shelf was exposed and not glaciated. The permafrost still exists today in a submarine environment after the last transgression, because the low seawater temperatures prevent efficient melting. Even if the existence of the submarine permafrost is confirmed by drilling at several locations, the distribution of the permafrost and its possible degradation in different areas, which may lead to a release of greenhouse gases, is only partially known. Therefore, high-resolution multi-channel seismic data as well as sediment echosounder and sidescan data were collected during Expedition Transdrift X. This expedition was carried out in September 2004 in a Russian-German cooperation between the GEOMAR (Kiel, Germany), the VNIIO (St. Petersburg, Russia) and the University of Bremen (Germany). As seismic source, a Mini GI Gun was used; the seismic signals were recorded with a new 48-channel streamer especially designed for shallow water operation. The main goal of the expedition was the imaging and interpretation of the seismic facies in the working area and especially the analysis of the distribution and character of submarine permafrost. Finally, the results should be used to determine optimum locations for a planned drilling campaign.

At the workshop, we will give an overview of the different structures found in the shallow seismic data from the Laptev Sea. The southern shelf is characterized by large areas with strong acoustic blanking which indicates the occurrence of free gas. A prominent reflector with steep topography is interpreted as former terrestrial surface. Additionally, a prominent fault was crossed on the southern shelf. The main focus of the cruise was a seismically strong interface, which shape and scale seems to be similar to today's thermokarst landscapes of the Siberian coastlands including ice-complexes and filled thermokarst lakes. The strong reflection of the interface indicates the presence of frozen sediments and is therefore thought to represent the top of the submarine permafrost. A dense grid of seismic and acoustic data was collected crossing this prominent reflector to get a 3-D image of its distribution and shape. The presence of gas in small patches is also suggested by the seismic data in this area, and in some parts of the profiles a prominent deeper reflector is imaged. West of the main study area, the permafrost reflector becomes prolonged, which may indicate the degradation of the permafrost and/or the (additional) presence of gas. East of the main study area we crossed a shallow bank which is characterized by a different seismic facies, namely mostly parallel layered reflectors

beneath a seafloor reflector of strong amplitude. It is believed that this facies represents a sandbank which may have been the base of a former ice-complex island.

QUINSIB – THE DATABASE OF QUATERNARY INSECTS IN NORTH-EASTERN SIBERIA

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Fossil insects are known to be reliable indicators of the past environment and climate. Large material on Pleistocene insect fossils has been collected in the recent years in north-eastern Siberia, in particular, during the expeditions under the "Laptev Sea System" Project. The results of study of key Quaternary sections (e.g., in the Lena Delta and Bolshoy Lyakhovsky Island) were repeatedly reported at the Laptev Sea Workshops and the meetings under QUEEN and other projects, and published in scientific journals.

Since 2001, a group of scientists from different Russian institutions has been bringing together all data on the Late Cenozoic insects in north-eastern Siberia. This work was in different times supported by the Otto Schmidt Laboratory, the Russian Foundation for Basic Research, Moscow State University and the institutes of the Russian Academy of Sciences. In the end of 2005, the first version of the Database of Quaternary Insects in North-eastern Siberia (QUINSIB) has been completed (the authors: A.V. Sher, S.A. Kuzmina, S.V. Kiselyov, B.A. Korotyaev, A.V. Alfimov, and D.I. Berman). The Database covers the results of paleoentomological research in the North-East of Asia conducted during the last 30-35 years. It includes more than 600 fossil insect assemblages from dozens of geological sections, ranging from the Pliocene to the Holocene in age. Modern distribution and ecology of more than 400 insect taxa (mostly beetles, Coleoptera) is characterized, as well as their occurrences as fossils. The Database includes 13400 records. This is the first instrument for the detailed qualitative and quantitative analysis of faunal history of insects in north-eastern Siberia and for tracing environmental changes in this region during the Pleistocene deduced from such analysis. The Database is already being used for the work on the current OSL project.

This is the first public presentation of the QUINSIB Database. Currently, the authors work over the corrections and additions to the first working version of the Database. In the future, it is supposed to place the demo version of the Database on the OSL server. Access to the full version of QUINSIB will be allowed to the scientists on their request and by agreement with the authors.

NITRITE OXIDATION IN PERMAFROST AFFECTED SOILS IS PERFORMED BY A NEWLY DISCOVERED BETAPROTEOBACTERIUM

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Nitrification – the biological oxidation of ammonia to nitrite and further to nitrate - is of fundamental importance for the functioning of the global nitrogen cycle in marine and terrestric habitats. Little is known about the function in extreme habitats like permafrost soils. Organisms responsible for the second step of nitrification (*Nitrobacter*, *Nitrococcus*, *Nitrospina*) are phylogenetically affiliated to the *Alpha-, Gamma-,* provisionally *Deltaproteobacteria* or the deep-branching bacterial phylum *Nitrospira*. In the past, classification of nitrifying bacteria was based on cell shape and ultrastuctural criteria and is nowadays mainly performed by 16S rRNA sequence analysis. Great variance of the fatty acid profiles of nitrite oxidizing bacteria provide another tool for taxonomic investigations.

Permafrost affected environments of the Siberian Arctic were investigated with regard to identification of dominant nitrite oxidizing bacteria active at low temperature. Analysis of the fatty acid profiles of nitrite-oxidizing enrichment cultures grown at 4, 10 and 17°C clearly revealed a lipid pattern which is typical for *Betaproteobacteria* but different from all know nitrite oxidizing genera. Electron microscopy of the enrichment culture grown at 10°C showed prevalent cells with an unique ultrastructure. Short straight rods were surrounded by an extraordinary wide periplasmic space at the longitudinal axis resulting in a coccoid overall appearance. Identity of such cells was confirmed with monoclonal antibodies recognizing the key enzyme of nitrite oxidation. Sequence analysis of the 16S rRNA genes provided evidence that the organisms belong to an uncultivated cluster of the *Betaproteobacteria.* Our results indicate that temperature is a selective factor for the enrichment of a novel genus of nitrite oxidizing bacteria, dominant in the active layer of the permafrost affected tundra soil at low temperature and at very low nitrite concentrations.

MONITORING PAST AND PRESENT ENVIRONMENTAL CHANGES IN THE LAPTEV SEA USING OSTRACODS

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Three different ecological assemblages of ostracods were established in surface sediments of the Laptev Sea. Comparison of fossil assemblages from AMS^{14}C-dated sediment cores obtained from the eastern shelf area with their modern analogues allowed us to reconstruct paleoenvironmental changes that occurred during the postglacial transgression and considerably supplement previously obtained data.

Significant variability has been observed in the distribution of modern ostracods in surface sediments of the Laptev Sea that reflects varying water depth and salinity. The species-rich and abundant assemblage of the western-central region of the Laptev Sea was related to Atlantic waters occupying the upper continental slope. It is characterized by relatively deep-water forms that show clear affinities to North Atlantic and Arctic Ocean assemblages (*Cytheropteron biconvexa, C. perlaria, C. tumefactum, C. inflatum, C. porterae, Krithe glacialis,, Pseudocythere caudata, Polycope* spp.). In the eastern middle shelf region, the assemblage is comprised of *Acanthocythereis dunelmensis* together with other normal marine species (*Semicytherura complanata, Elofsonella concinna, Cluthia cluthae*). The inner shelf assemblage of the southern Laptev Sea is dominated by shallow-water euryhaline species (*Paracyprideis pseudopunctillata* and *Heterocyprideis sorbyana*) with admixture of the brackish-water species *Cytheromorpha macchesneyi*. The unusual finding of a number of shallow-water ostracod species on the upper continental slope was supposed to be due to ice-rafting which these ostracods are probably able to survive.

Comparison of the recent ostracod association of the Laptev Sea with those from other Arctic areas revealed that it is most similar to the assemblage of the Kara and Beaufort seas, that reflects similar environmental conditions in these seas.

Analysis of fossil assemblages from AMS^{14}C-dated sediment cores and comparison of established assemblages with modern analogues allowed us to reconstruct the development of the postglacial transgression in different parts of the sea. Three phases of transgression were established on the central part of the shelf of the eastern part of the sea. During the first phase (11.3-11.1 cal. ka in the Yana paleovalley and 11.2-10.8 cal. ka in the Lena paleovalley) a nearshore brackish-water environment with depths less than 10 m, reduced (on average 18-20) and seasonally variable bottom salinity predominated. During the second phase (11.1-10.3 cal. ka in the Yana paleovalley and 10.8-8.2 cal. ka in the Lena paleovalley) shallow-water environment affected by fluvial runoff, with water depths around 20-25 m and average bottom salinity around 26-28 existed. The third phase started at about 10.3 cal. ka in the Yana paleovalley and 8.2 cal. ka in the Lena paleovalley and encompassed the transition to the onset of present marine environment with bottom salinity around 30-32.

The ostracod data from the core located close to the Lena delta indicate that nearshore brackish water environment with considerable fluvial influence and relatively low sedimentation rates (30 cm/kyr) existed starting from 6.4 cal. ka. A shift to modern-like conditions began at ~2.7 cal. ka and, probably, an increase in river run-off or change in its direction occurred around 1.5 cal. ka.

POSTGLACIAL TO HOLOCENE ENVIRONMENTAL CHANGES AT THE LAPTEV SEA CONTINENTAL MARGIN AS DEDUCED FROM FOSSIL BENTHIC ASSEMBLAGES

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Four AMS^{14}C dated cores from the Laptev Sea continental margin obtained in 1998 during TRANSDRIFT V expedition aboard r/v Polarstern were taken for benthic assemblages studies (molluscs, ostracods, planktic and benthic foraminifers). In the western Laptev Sea, core PS51/154-11 from the upper continental slope (270 m water depth) dates back to >15.8 cal.ka and represents so far the longest age-controlled record of postglacial to Holocene events in the Laptev Sea region. Three cores from the outer-middle shelf originate from the submarine river paleovalleys of the Khatanga, Lena and Yana and age back to 12.7, 11.2, and 11.3 cal.ka, respectively.

On the upper continental slope, high relative proportions of benthic foraminifer species *Cassidulina teretis*, planktic foraminifers and relatively deep-living ostracods with North Atlantic affinities provide evidence on the past inflows of Atlantic-derived waters, whereas freshwater inputs, downslope sediment movements and ice-rafting are documented by the presence of euryhaline, brackishwater and freshwater ostracods and low planktic/benthic ratio. Atlantic-derived waters reached the studied site in the western Laptev Sea continental slope already 15.8 cal.ka, i.e prior to the establishment of the pathway through the Barents Sea shelf further west, and were then constantly present in the area. Cold and low-nutrient benthic marine environments with recurrent coastal open-water polynya are reconstructed for the period 15.8-14.1 cal.ka. Gradually increasing freshwater influence during the subsequent period reached its maximum between 12.7-11.2 cal.ka, when the outer shelf was flooded.

During the earliest stage of shelf flooding, the pioneer brackishwater assemblages of bivalves and ostracods inhabiting the estuarine parts of river paleovalleys were subject to periodical advection of saline offshore waters, as indicated by the presence of deep-living ostracods and planktic foraminifers. Following the pattern of sea-level rise, these strongly fluvially-affected assemblages rapidly transformed into shallow-water marine ones.

After 3.5-3 cal.ka, when the sea level was at its modern position, the well-pronounced changes in the composition of benthic assemblages from both, the outer shelf and upper continental slope, indicate climate cooling combined with the intensification of surface and bottom water circulation. On the outer shelf, this is manifested by the increase in the number of euryhaline ostracods ice-rafted from the inner-shelf regions, and re-introduction of deep-living species due to the advection of Atlantic-derived water with reversal bottom currents. On the upper continental slope, peak values of planktic foraminifers, *C. teretis*, euryhaline ostracods, and ice-rafted debris, all point to the increase in Atlantic-derived waters inflow, climate cooling and intensification of the wind-driven surface water circulation.

THERMOKARST LAGOONS OF THE LAPTEV SEA

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The Laptev Sea is one of the marginal shelf seas of Russian Eastern Arctic, and it was under the influence of the World ocean level oscillations during the whole Quaternary.

At the end of XX century, a conception of development of postglacial transgression in this area was elaborated, on a base of new ideas concerning the role of cryogenic processes (Romanovsky et al., 1999). It stated that a wide development of thermokarst lakes strongly affected the transgression course and frozen deposits transformation over the shelf. This wasn't taken into account earlier.

Thermokarst lakes were forming along the deposits of high-icy sincryogenic Ice-Complex deposits. Under the lake, lake taliks were formed, at a depth of 100-150 m. Eventually, these depressions were submerged by sea water, transforming into the "thermokarst lagoons". This leaded to various geological, geocryological, geochemical and biological changes of inner ambience inside the lagoons. Variety of these changes was under the influence of development stages of thermokarst depressions at the moment of submergence, and its lateral and latitude position.

In 2004-2005, field studies of thermokarst lagoons on the Bykovsky peninsula (Lena river delta) have been performed. Three lagoons were studied: Ivashkina, Uomullyakhskaya and Pestsovaya. At present time, lagoons pass different stages of development – from early stage of submergence (Pestsovaya) till partial destruction of primary hollow (Uomullyakhskaya). During the field works, we drilled holes following hollow profiles and sampling cores for further analytic studies, and performed thermometric measurements. As a result, we estimated modern values of lake taliks (15-18 m), water and bottom deposits temperature regime, stratigraphy of lagoon and underlying deposits of alas complex.

At the present time we continue analytical studies of borehole cores in the OSL.

ARCHAEAL ACTIVITY AND BIOMASS IN PERMAFROST SOILS AND DEPOSITS OF THE LAPTEV SEA REGION

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Wet tundra environments of the Siberian Arctic are natural sources of the climate relevant trace gas methane. In order to improve our understanding of the present and future carbon exchange in dynamic permafrost environments the methane content as well as the activity, diversity and physiology of the methanogenic community have to be studied. For these investigations permafrost soils as well as permafrost cores of Holocene and late Pleistocene age from the Lena Delta (N 72°, E 126°) were used.

The quantity of dissolved organic matter (DOM), which represents an important C pool for microbial communities in permafrost soils, correlated significant with the total concentrations of phospholipid fatty acids and ether lipids (PLFA and PLEL) a measure for microbial biomass. Although permafrost soils represent a large carbon pool, it was shown, that the reduced quality of organic matter leads to a substrate limitation of the microbial metabolism. This is an important finding for modelling and calculating trace gas fluxes from permafrost environments, because the known models are consider only the total carbon amount.

First results of permafrost core studies showed that the deposits are characterized by silty material with a high ice content between 11 and 35 %. The organic carbon of the core material varied between 0.6 and 4.9 %. In all permafrost deposits a high CH_4 concentration were proven and methanogenesis could be initiated after thawing of the sediment. Even the incubation of soil material at –3 °C (0.1 – 11.4 nmol CH_4 h^{-1} g^{-1}) and –6 °C (0.08 – 4.3 nmol CH_4 h^{-1} g^{-1}) showed a significant CH_4 production. Phospholipid etherlipid (PLEL) analysis revealed a high amount of archaeal biomass in perennially frozen sediments with

high concentrations of methane. Even up to 8.5 m permafrost depth archaeal PLEL were detected, although at low amounts.

The results indicated the existence of a permafrost microbiota, which has well adapted to the extreme environmental conditions. Furthermore, first evidence of modern methanogenesis in the perennially frozen sediments was given by microbial activity and PLEL analysis. The characterization of pure cultures of methanogenic archaea obtained from permafrost environments should deliver detailed information of metabolic activity, survival potential and adaptation strategies of the microorganisms in extreme habitats.

SEASONAL BOTTOM-WATER TEMPERATURE VARIATIONS ON THE LAPTEV SEA SHELF – EVIDENCE FROM ONE-YEAR RECORDS

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Submarine permafrost is an important feature of the seafloor of the Laptev Sea and was formed under subaerial conditions during the last glacial. After submergence submarine permafrost degrades, thawing from the seabed downwards by the influx of salt and heat as a result of the new oceanographic boundary conditions, even in the presence of negative mean seafloor temperatures. Therefore its present state is highly transient. Changes in temperature distribution within the water column and in hydrodynamic conditions are of major importance as they directly influence the energetic balance of the submarine permafrost. For that reason process studies on the interaction between atmosphere, water column and seafloor/submarine permafrost were carried out to characterize the stability factors of the submarine permafrost.

Three seafloor observatories equipped with Acoustic Doppler Current Profilers (ADCPs) and temperature sensors were deployed each for the period of one year (August 1998-September 1999; September 2003-August 2004) to monitor the seasonal variability of bottom water temperature and of the current system on the eastern Laptev Sea shelf. The time-series of bottom-water temperature showed unexpected variations in the inner-shelf area as well as on the mid-shelf. It used to be widely accepted that bottom-water temperatures beneath 0° C prevail in water depths between 20 and 50 m on the Laptev Sea shelf. One-year observations on the inner shelf, however, reveal a sudden increase in bottom-water temperature up to 2.75° C at the end of September/ beginning of October 2003 for a two-week period. Such high bottom-water temperatures in these water depths are most unusual in Siberian shelf seas and might cause thawing of submarine permafrost at the seafloor surface. An increase in bottom water temperature during the end of the ice-free period seems to be a common phenomenon within the density front of the Lena River on the inner Laptev Sea shelf. Lowest bottom-water temperatures were recorded on the inner shelf during December/January (in both years) probably caused by polynya dynamics right above or nearby. Bottom-water temperature dynamics on the mid-shelf are different and not clearly related to atmospheric and sea-ice conditions. An increase in bottom-water temperature was recorded in May 1998 which might be related to upwelling-events along the Laptev Sea's continental margin.

NEW EVIDENCE ON THE LATE PLEISTOCENE ENVIRONMENT IN THE SOUTHERN CHUKOTKA ACCORDING TO THE STUDY OF FOSSIL INSECT ASSEMBLAGES (PRELIMINARY RESULTS)

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The expedition research in southern Chukotka was carried out in 2004 by the following team: A. Sher, S. Kuzmina (Paleontological Institute RAS, Moscow), A. Kotov (Chukotka Branch of NEISRI FEB RAS, Anadyr), E. Willerslev, J. Haile (Oxford University, UK) and E. Yan. By present, we have obtained preliminary results of study of 36 fossil insects samples obtained from the key section Ledovyy Obryv (Ice Bluff) on the Main River. The section covers the time period from 42 to about 15 ka. The main feature of insect assemblages from this section is the complete absence of true steppe species, which is rather unusual for Siberian insect faunas in general. The percentage of other species indicating tundra-steppe environment is also not very high. The variation in faunal composition through the section allows preliminary recognition of certain climatic periods, including the LGM. The peak of cooling occurred here about 21 ka, when the assemblages are dominated by arctic species, such as a weevil *Isochnus arcticus*, which can reach more than 30% in some samples. Compared to the Lena Delta sequences (Mamontovy Khayata on Bykovsky Peninsula and Byor-Khaya on the Olenyo Channel), this peak seems to be less sharp; this t can be explained by essentially more southern position of the Chukotka section. The preliminary general conclusion is that the climatic changes in southern Chukotka were smoother and more stretched in time, and the environment was not so xeric than further west. Contrary to the western regions of Beringida, the tundra-steppe assemblages here had much more pronounced tundra component than the steppe one. Probably, this should be explained by the effect of relative proximity of the Pacific. Completing the analysis of insect assemblages will allow us to compare regional environments of the LGM and the preceding time from the west to east in Beringida along the transect from the Lena Delta to the Kolyma Lowland, southern Chukotka and Alaska.

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COMMUNITY SIZE, STRUCTURE AND ACTIVITY OF METHANE OXIDIZING BACTERIA IN SOILS AND SEDIMENTS OF PERMAFROST LANDSCAPES

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Arctic wetland soils are substantial natural sources for the climate relevant trace gas methane. Global change yet resulted in a considerable temperature increase in the Arctic which might increase microbial methane production in high latitude wetlands. Aerobic microbial methane oxidation is the most important process for reducing the release of methane to the atmosphere from these environments. We studied the activity and community structure of methane oxidizing bacteria (MOB) and their response to environmental change in the northern Siberian tundra. Investigation sites were two waterlogged soils (peat and organic rich mineral soil) and underlain perennially frozen sediments. The size and structure of the MOB community was investigated using group-specific phospholipid fatty acids (PLFA) as biomarkers for type I and type II MOB. Active MOB were identified by labelling soil samples with ^{13}C-methane and measuring the ^{13}C-content of specific PLFA. Potential methane oxidation rates and the temperature response were measured by batch incubation.

MOB biomarkers were highly abundant in the top soils and contributed up to 4.5% to the total PLFA present. Calculated on a community level, up to 14% of the total

microorganisms were methane oxidisers. However the peat soil (37 % C_{org}) contained 15 times more fatty acids specific for MOB (9.2 nmol cm^{-3}) than the organic rich mineral soil (18% C_{org}). Both in the active layer and in the frozen sediments almost exclusively biomarkers for type I organisms were found. Latter results were confirmed by ^{13}C-labelling experiments with samples from the active layer where we identified more than 85% of ^{13}C incorporated into biomarkers of type I and only 4% in those for type II. In permafrost samples, type II organisms were even less important indicating a minor adaptation of this group to the permafrost environment. Concentrations of MOB biomarkers decreased with depth in both waterlogged soils as did the potential activity of MOB. Methane oxidation rates were highest (6-9 nmol CH_4 cm^{-3} h^{-1}) close to the water table and dropped to zero at a soil depth of about 20 cm. However, both lower parts of the active layer and perennially frozen sediments without measurable activity still contained a considerable amount of MOB biomarkers. Furthermore, long time incubations revealed that MOB could be reactivated, indicating the survival of inactive spores or cells. Maximum methane oxidation rates were found around 25 °C in both soils. Long time incubations revealed that the composition of the active MOB community changes in response to rising temperatures (see poster on temperature adaptation by U. Zimmermann et al.). Our results show that MOB communities in the lower part of the active layer and the frozen sediments are inactive under *in situ* conditions but rapidly can be reactivated. Temperature is not only affecting methane turnover rates but also community structure of MOB, demonstrating the capacity of the autochtonous methane oxidising community to adapt to changing environmental conditions.

TEMPERATURE ADAPTATION OF METHANE OXIDIZING BACTERIA IN PERMAFROST AFFECTED HABITATS

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Microbial methane oxidation is an important constraint of methane emissions from Arctic wetlands. In this study, we investigated the effect of temperature on methane turnover in three north Siberian tundra soils and in underlying perennially frozen sediment. Furthermore, the influence of temperature on community structure of methane oxidizing bacteria (MOB) was studied in long time laboratory incubations using ^{13}C-labelling experiments and phospholipid fatty acid (PLFA) analyses.

All three soils showed maximum methane turnover rates between 22 and 28°C, much higher than the *in situ* temperatures. However, the relative activity at 0°C varied considerably. One soil retained 30 % of its maximum methane oxidation activity in contrast to the others with 9 % or less, indicating the presence of psychrotolerant MOB communities with different adaptations to low temperatures. The investigated perennially frozen sediment was only active after a pre-incubation at elevated temperature and oxygen concentrations, suggesting a MOB community inactive under *in situ* conditions. Temperature strongly influenced the duration of the reactivation phase. At 37°C MOB were active after 3 days and at 0°C after 26 days of incubation. The maximum for methane oxidation in the perennially frozen sediment occurred at similar temperatures as in the active layer, with even a slight shift to higher temperatures. The group of “type I” organisms dominated active or reactivated MOB communities in all investigated permafrost affected habitats. Long time incubations revealed that at 0°C the active MOB community was still dominated by “type I” organisms as under *in situ* conditions. In contrast both “type I” and “type II” were almost equally important after incubation at 22°C, indicating a change in community structure as response to a higher temperature.